The European exchange of information in 2012

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Front page picture:
Lowest station in AirBase (4 meter below sea level), station Wieringerwerf-Medemblikkerweg (the Netherlands), station EoI code: NL00538 (photo ©RIVM, Bilthoven, the Netherlands)

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SUMMARY

Every year the European Topic Centre on Air pollution and Climate change Mitigation (ETC/ACM) prepares a technical paper on the meta information and air quality data that have been exchanged among the EU Member States (MS) and the Commission. Besides the EU Member States, other member and cooperating countries of the European Environment Agency, which include EU (potential) candidate countries and European Free Trade Association (EFTA) countries, have agreed to follow this reporting procedure as well. The content of AirBase (version7) is available to the public via the European Environment Agency (EEA) website[1]. More information on AirBase can be found on the ETC/ACM website[2]. The results of the reporting cycle presented in this technical paper cover data for 2011.

A total of 38 countries, including the 27 EU MS, have provided air quality data for 2011. As in preceding years, a large number of time series have been transmitted, covering, for example, sulphur dioxide (SO_2), nitrogen dioxide (NO_2), nitrogen oxides (NO_x), particulate matter (PM_{10}, $PM_{2.5}$), ozone (O_3), carbon monoxide (CO) and benzene (C_6H_6). In an increasing degree also Volatile Organic Compounds (VOC), Heavy Metals (HM) and Polycyclic Aromatic Hydrocarbons (PAH) have been transmitted. A few countries have also delivered $PM_{2.5}$ speciation concentrations ($PM_{2.5}$_spec).

Almost all the countries that have updated their meta information have used the Air Quality Data Exchange Module (AQ-DEM)[3], that is made available for this purpose by the ETC/ACM.

This technical paper describes the meta information and the quality of the measurement data of the provided air quality data for 2011. An overview of the state of the air quality for selected pollutants in 2011 will be provided in the EEA Air quality report (EEA, 2013, in prep.).

[1] http://www.eea.europa.eu/themes/air/airbase
[2] http://acm.eionet.europa.eu/databases/airbase/
[3] http://acm.eionet.europa.eu/databases/country_tools/aq/aq-dem/index_html

CONTENTS

INTRODUCTION

The reciprocal exchange of information and data among countries and the European Commission is based on the Air Quality Directive (AQD) 2008/50/EC (EU, 2008)). This Exchange of Information (EoI) Decision 'establishing a reciprocal exchange of information and data from networks and individual stations measuring ambient air pollution within the Member States', was formerly established in the EoI Decision 97/101/EC and annexes (EU 1997, EU 2001a and EU 2001b).

Parallel to the dataflow under the EoI, the Member States (MS) of the European Union (EU) provide information on air quality in the context of the former Air Quality (AQ) Framework Directives (FWD) and related daughter directives (DD). These Directives have been merged into the AQD 2008/50/EC (EU, 2008)) except for the fourth DD (4DD, EU 2004a). This information mainly focuses on compliance checking with obligations under the AQ directives, such as limit values. To avoid duplicate reporting by the MS, some of the meta data that is needed for evaluating the reports under the FWD (in particular the meta-information on stations and networks) is only sent under the EoI.

Rules for implementing the reporting system under the Directives 2008/50/EC and 2004/107/EC (Implementing Provisions, IPR) are established in Decision 2011/850/EU (EU, 2011) and will apply from the end of a 2-year transitional period commencing at the date of their adoption on 31 December 2013. Until that date the EoI Decision 97/101/EC remains applicable (see Article 31.4 in the AQD 2008/50/EC (EU, 2008). An accompanying Guidance document (EU, 2013) is in development. For the time being the EoI data submission still follows the Guidance based on the revised Annexes of the Decision (Garber *et al*. 2001).

The EoI requires a large set of meta information and AQ data to be delivered to the Commission. Part of this information is mandatory and the other items are to be delivered to the Commission 'to the extent possible' and 'as much information as feasible should be supplied' (see Annex A).

The ETC/ACM, on behalf of the EEA, prepares each year a technical paper on meta information and AQ data exchanged, and makes the information available to EU MS. The decision states that the Commission will call on the European Environment Agency (EEA) with regard to the operation and practical implementation of the information system. The European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM), under contract to EEA, manages the database system, AirBase (see Mol and de Leeuw 2005). The information submitted under the EoI is stored in AirBase. Statistics based on the delivered information are calculated and also stored in AirBase (see Annex B). In AirBase also NO_x values have been derived for stations where NO and NO_2 values have been reported, but no NO_x values. The contents of AirBase are available to the public via the EEA website[4] and ETC/ACM website[5]. On the ETC/ACM website also background information on AirBase can be found.

AirBase is the central database for the AQ meta information for the different AQ data flows: (EoI, FWD questionnaire (EU, 2004b), summer ozone reporting (SOR)), the Up To Date (UTD) Web site[6].

[4] http://www.eea.europa.eu/themes/air/airbase
[5] http://acm.eionet.europa.eu/databases/airbase/index_html
[6] http://www.eea.europa.eu/maps/ozone/welcome

This report shows information provided by the 27 EU Member States (EU-27). In addition it contains information from the other five EEA member countries and from the six EEA cooperating countries[7], which have agreed to follow the data exchange procedures in the framework of Euroairnet[8].

This report also refers to the QA/QC aspects of the data in AirBase. The procedures and the QA/QC checks are described in some reports (see Mol, 2012). The standard checks on the delivered EoI-data are: outliers, strange statistics, missing data, missing essential meta data, potential overwriting of data already stored in AirBase, potential deletion of stations and measurement configurations with data. In addition to these standard checks also QA/QC checks are performed on questionable station coordinates.

This report only describes the technical aspects of the data submission process. The state of the air quality for selected pollutants in 2011 will be described in the EEA Air quality report (EEA, 2013).

EoI Technical Papers for earlier years can be found on the ETC/ACM Website[9]

[7] EU27 Member States: Austria, Belgium, Bulgaria, Denmark, Finland, Germany, Greece, Spain, France, Ireland, Italy, Luxembourg, The Netherlands, Portugal, Sweden, United Kingdom, Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Romania, Slovenia, Slovakia. In addition to the 27 EU Member States the four EFTA Countries (Iceland, Liechtenstein, Norway and Switzerland) and Turkey are EEA member countries (EEA 32 member countries). EEA cooperating countries are: Albania, Bosnia and Herzegovina, Croatia, Former Yugoslav Republic of Macedonia (FYROM), Serbia and Montenegro.

[8] http://acm.eionet.europa.eu/databases/databases/EuroAirnet/index_html

[9] http://acm.eionet.europa.eu/databases/airbase/eoi_reports

1. EXCHANGE OF INFORMATION 2012 (DATA FOR 2011)

1.1. Data delivery

Thirty eight countries, including the EU-27 MS, provided AQ data for the reporting year 2011 (see the status table in http://acm.eionet.europa.eu/country_tools/aq/eoi_to_airbase_status/index_html)

The delivery of data was facilitated by the AQ Data Exchange Module (AQ-DEM)[10]. This tool was used by almost all countries. Only one country provided its data in files in DEM format These files were uploaded in the DEM by the ETC/ACM, to allow for the same kind of checks that are performed for the other countries. All data delivered for the reporting year 2011 was loaded into AirBase (version 7). All statistics and exceedances relevant in the AQD 2008/50/EC and 4DD have been calculated and were also loaded into AirBase. Also NO_x values have been derived and loaded in AirBase (by ETC/ACM) for those stations where NO and NO_2 values have been reported, but no NO_x values.

1.2. QA/QC feedback actions

Several quality checks have been performed on delivered data. The quality checks in all steps of the EoI delivery process are described in a working document (see Mol, 2012).

For those countries applying the DEM, the first quality checks on the reported data are performed in the DEM itself. The DEM is prefilled with all meta information of the lastest available version of AirBase. The data supplier can sequentially modify the available meta information and/or add new meta information, followed by the import of the raw data into the DEM.
If DEM-files are delivered, ETC/ACM loads these data in the DEM itself. During the import of meta information and raw data automatically semantic and syntactic format checks are performed. Error messages and warnings are given for mandatory (see Annex A), essential and desired (important) parameters. Also checks are performed for the data values. Information is given on the unit value of the components.
There is a map facility for checking if a station is positioned within country borders. The station position can also be checked in Google Earth. After import of the data, the data supplier can check the data in various ways:

- Check on outliers. For each component a default lower and upper value is defined, but it is also possible to change these values (per country) into a country dependent lower and upper value.
- Check on calculated statistics. Overviews with statistics calculated from the imported measurement data are generated. The imported data can be checked on: zero or negative statistics or statistics which are 3 times lower or higher compared to the year before.
- Check on missing imported data. The DEM gives information on data which were reported the year before but not now, or data which have been reported now but not the year before (showing that there is a gap in the timeseries for the current or previous reporting year).

The imported measurement data can also be checked by visual inspection (graphs, bar charts). The DEM can export the imported data in several formats: MS Excel, DEM format, XML Google Earth kml format. The data can also be checked by inspecting these exports.

After delivery, the DEMs (including the generated DEM for the country which delivered DEM files) are uploaded into AirBase. ETC/ACM repeats the DEM checks on outliers, calculated statistics and missing data. Moreover ETC/ACM performs some additional checks:

[10] http://acm.eionet.europa.eu/databases/country_tools/aq/aq-dem/dem_install.html

- Check on missing essential meta information (station coordinates, altitude, type of station, type of area).
- Resubmission of data: measurement data, already available in AirBase, has been submitted again.
- Stations and/or measurement configurations which have to be removed from AirBase, but measurement data are attached to these stations and/or measurement configurations.

Other checks (part of an activity in the ETC/ACM Implementation Plan called "Improving air quality data capture including near real-time data flows"). on the EoI:

- No response on regular feedback after EoI delivery.
- Check on coordinates (stations in other country, in the sea etc.).
- Stations Questionnaire and/or NRT and/or SOR missing in AirBase.
- Double/multiple defined stations with the same coordinates.
- NO_x or NO_2+NO measurement values delivered?
- Gaps in historical time series.

Intensive feedback took place with all reporting countries on these items. The feedback reports sent to the MS resulted in one or more updates for the respective countries of the original EoI reports like:

- Revalidation of suspicious data, originally reported as valid.
- Resubmission of time series in which suspicious data were detected.
- Updating (essential) meta information.
- Submission of missing time series.

More detailed information on the country feedbacks can be found in Annex C.

1.3. Reporting characteristics

Sulphur dioxide (SO_2), nitrogen dioxide (NO_2), nitrogen oxides (NO_x), ozone (O_3), carbon monoxide (CO), particulate matter (PM_{10}, $PM_{2.5}$), benzene (C_6H_6) and lead (Pb) were the most frequently reported pollutants. Fewer time series were submitted for the less commonly monitored components, i.e. Volatile Organic Compounds (VOC), Heavy Metals (HM) and Polycyclic Aromatic Hydrocarbons (PAH). Some countries have delivered $PM_{2.5}$ speciation data ($PM_{2.5}$_spec). The latter is a new requirement in the AQD 2008/50/EC (Article 6(5)).

The number of reporting countries varied per component ranging from all 38 countries for PM_{10}, to nineteen for VOC components (VOC minus benzene, see Annex D).

The number of reporting stations in 2011 also varied accordingly (excluding the $PM_{2.5}$_spec stations), being 489 for one or more VOC- and 3191 for NO_2. Differences in the distribution and density of reporting stations are illustrated for selected pollutants (*Figures 1 through 8)*[11]. The expected coverage of EoI stations in these figures is set out in Article 3 of the EoI decision (EU 1997). The EoI should cover at least the stations which are used in the Air Quality Directive. Only if the concentrations are below the lower assessment threshold (LAT) it is not necessary to deliver fixed measurement data (EU, 2008 (Annex II)).

Overviews of reporting in 2011 can be seen in *Tables 1 and 2* in this report. For completeness the tables also show the number of stations with NO_x data, or, if no NO_x data are available with NO_2 + NO data (symbol "NO_x/NO") and the number of stations providing data for one or more O_3 precursors excluding benzene which is listed separately (VOC-) and the number of stations with data for one or more of the heavy metals in the 4th DD (HM4: As, Cd, Hg, Ni) and one or more PAH in the 4th DD (PAH4). Only *lead in aerosol* (Pb_aer) has been taken

[11] Note that a number of French stations (Reunion, Guadeloupe,...) fall outside the maps; these stations are however included in the Tables and other graphs.

into account. Also the $PM_{2.5}$ speciation stations are added. For a detailed definition of HM4, PAH4, Pb_aer and $PM_{2.5}$_spec, see Annex D).

The stations in AirBase have a station type: traffic, industrial, background or unknown and a type of area: urban, suburban, rural or unknown. The type of stations in *Table 1* has been defined as follows:

Station classification	Type of station in AirBase	Type of area in AirBase
Traffic	Traffic	Urban, suburban, rural, unknown
Urban background	Background	Urban, suburban
Industrial	Industrial	Urban, suburban, rural, unknown
Rural background	Background	Rural
Other	Background	Unknown
	Unknown	Urban, suburban, rural, unknown

More detailed information on the number and type of stations per pollutant and per country in 2011 can be found in table A "number of stations per pollutant and station type and country in 2011"in:
http://acm.eionet.europa.eu/databases/airbase/eoi_tables/eoi2012/index_html

All stations with data (stations with raw data with averaging times varying from hour to year and/or statistics) are taken into account in this chapter, regardless of the data coverage[12] at that station[13]. For the gaseous components mostly hourly and daily concentration data have been delivered. The components from the 4th DD (HM4 and PAH4) and $PM_{2.5}$_spec components have different averaging times than hour and day: the averaging times can be weekly, 2-weekly, 4-weekly, monthly, 3-monthly and yearly. If the measurement periods of a component differ more than 25% from a constant averaging time, the averaging time has been defined as "var".

The daily values in AirBase have been calculated by ETC/ACM from the hourly values (if available). If a country reports both hourly and daily values, the delivered daily values have been overwritten by the calculated daily values. If 3-hourly data are delivered, these data are aggregated in daily values; in this case only the aggregated daily values are made available in AirBase.

Most countries delivered data for more pollutants than the mandatory list of pollutants defined under the EoI. See table B "number of stations with HM4, VOC, PAH4 and other non-Directive components" in
http://acm.eionet.europa.eu/databases/airbase/eoi_tables/eoi2012/index_html for a summary of these supplementary components.

Compared to 2010, for 7 pollutants the number of stations for which data have been reported in 2011 has increased (see *Table 1)*. Only SO_2, NO_2, PM10, C_6H_6 and O_3 slightly decreased, for CO the number of reported stations decreased by 8%. The highest increases are in the number of stations measuring $PM_{2.5}$_spec (60%) and NO_x/NO (10%). The difference between the number of stations for which NO_2 has been reported and the number of stations for which NO_x /NO has been reported is 532. This is an improvement in comparison with 2010, where the difference was 847. See also table C "number of stations with NO_2, NO_x and NO" in
http://acm.eionet.europa.eu/databases/airbase/eoi_tables/eoi2012/index_html for an overview per country.

[12] In the Air Quality Directives 2008/50/EC and 2004/170/EC the terms *data capture* and *time coverage* have been defined. The time coverage is the percentage of measurement time in a given period. The data capture is the percentage of valid measurement values in a given data set. For each yearly time series the so called *data coverage* has been calculated in AirBase. The *data coverage* is defined as follows: *Data coverage = data capture * time coverage*.

[13] More specific: stations with data are stations with calculated or defined statistics (annual means).

Table 1 Number of stations for which 2011 data have been delivered for AQD 2008/50/EC & 4DD components, specified per station type. For a detailed definition of Pb_aer , VOC-, $PM_{2.5}$_spec, HM4 and PAH4 see Annex D.

	AQ Directive												
	AQD 2008/50/EC											DD 2004/50/EC	
	SO2	NO2	NOx/NO	PM10	PM2.5	Pb_aer	CO	C6H6	O3	VOC-	PM2.5_spec	HM4	PAH4
Reporting EU countries	27	27	26	27	27	23	27	27	27	20	9	25	23
Total number of stations	1821	3080	2581	2781	1046	659	1146	816	2144	483	24	750	569
Of which													
Traffic	337	953	714	805	242	155	532	336	251	192	2	158	150
Urban background	725	1225	1069	1175	543	259	380	278	1086	140	2	305	264
Industrial	500	490	425	443	109	136	177	140	281	108		143	67
Rural background	254	403	365	345	150	109	53	58	518	40	20	144	88
Other	5	9	8	13	2		4	4	8	3			
Reporting non-EU countries	9	10	10	10	4	1	9	5	9	1		3	2
Total number of stations	201	111	87	218	37	14	63	23	69	6		19	17
Of which													
Traffic	21	45	42	53	17	2	25	16	20	1		2	3
Urban background	142	38	25	134	12	5	22	4	21	4		6	8
Industrial	26	11	8	17	1		12	1	8			1	
Rural background	11	17	12	14	7	7	4	2	20	1		9	5
Other	1											1	1
Total reporting countries	36	37	36	37	31	24	36	32	36	21	9	28	25
Total number of stations 2011 data	2022	3191	2668	2999	1083	673	1209	839	2213	489	24	769	586
Total number of stations 2010 data	2098	3278	2431	3040	997	658	1314	860	2270	466	15	762	567
Increase stations 2010/2011 data	-76	-87	237	-41	86	15	-105	-21	-57	23	9	7	19
Perc. Increase stations 2010/2011 data	-4%	-3%	10%	-1%	9%	2%	-8%	-2%	-3%	5%	60%	1%	3%

Table 2 Number of stations for which 2011 data have been delivered for AQD 2008/50/EC & 4DD components, specified per country. For a detailed definition of Pb_aer , VOC-, $PM_{2.5}$_spec, HM4 and PAH4 see Annex D.The number of stations for individual components in VOC-, $PM_{2.5}$_spec, HM4 and PAH4 can be found in Table B "number of stations with HM4, VOC, PAH4 and other non_Directive components" on http://acm.eionet.europa.eu/databases/airbase/eoi_tables/eoi2012/index_html

	AQD 2008/50/EC											DD 2004/50/EC	
	SO2	NO2	NOx/NO	PM10	PM2.5	Pb_aer	CO	C6H6	O3	VOC-	PM2.5_spec	HM4	PAH4
EU-27 countries													
AUSTRIA	96	153	134	133	21	16	36	20	112	12		17	25
BELGIUM	61	87	87	65	42	40	22	39	42	39		45	22
BULGARIA	28	25	18	40	9	9	17	20	19	5		12	13
CYPRUS	2	2	2	3	5	3	1	1	2		1	3	2
CZECH REPUBLIC	74	91	91	120	44	62	27	30	61			62	33
DENMARK	2	12	7	6	8	6	6	3	9	3	2	6	2
ESTONIA	9	9	9	7	7	5	7	2	9			5	5
FINLAND	10	30	29	42	20	1	5	5	20	5	3	7	9
FRANCE	246	473	358	379	102	29	69	27	421			21	10
GERMANY	157	534	367	430	147	121	115	151	264	112	8	191	124
GREECE	10	24	16	18	4		14	2	24	1			
HUNGARY	25	25	24	25	8		22	13	17	13		7	20
IRELAND	11	14	14	17	7	3	5	3	12	3	1	6	5
ITALY	282	579	565	509	142	70	298	184	340	136		70	68
LATVIA	6	9	3	9	5	5	2	6	8	5	1	5	4
LITHUANIA	10	14	11	14	7	5	7	4	12	1		5	5
LUXEMBOURG	3	6	6	6	3	3	3	2	6	2		3	3
MALTA	4	4	4	4	3		4	3	5	3		1	
NETHERLANDS	20	59	44	48	29	7	21	6	38	6	1	8	6
POLAND	129	130	121	200	69	79	64	32	66	1	5	78	98
PORTUGAL	49	59	59	59	23	3	39	12	50	2		6	1
ROMANIA	72	56	56	44	18	38	69	35	58			37	
SLOVAKIA	12	16		31	26		10	10	15				
SLOVENIA	12	12	11	14	4	4	4	2	12	2		4	3
SPAIN	435	502	411	453	202	111	251	153	424	127		109	75
SWEDEN	9	35	14	41	18	4	4	10	16			4	2
UNITED KINGDOM	47	120	120	64	73	35	24	41	82	5	2	38	34
Total EU-27 countries	1821	3080	2581	2781	1046	659	1146	816	2144	483	24	750	569
non-EU-27 countries													
ALBANIA		2	2	2	2		2	2					
BOSNIA - HERZEGOVINA	4	1	1				2		2				
CROATIA	8	8	8	8			8	4	2				
ICELAND	7	6	5	8	6		1		1			1	
LIECHTENSTEIN		1	1	1					1				
MACEDONIA, FYRO[1)]	20	5	5	14			9		12				
MONTENEGRO	2	3	3	4			3		2				
NORWAY	10	31	25	31	21		2	10	11			4	8
SERBIA	25	23	6	6			24	4	8				
SWITZERLAND	9	31	31	28	8	14	12	3	30	6		14	9
TURKEY	116			116									
Total non-EU-27 countries	201	111	87	218	37	14	63	23	69	6		19	17
Total all countries	2022	3191	2668	2999	1083	673	1209	839	2213	489	24	769	586

[1)] FYRO = the Former Yugoslav Republic Of

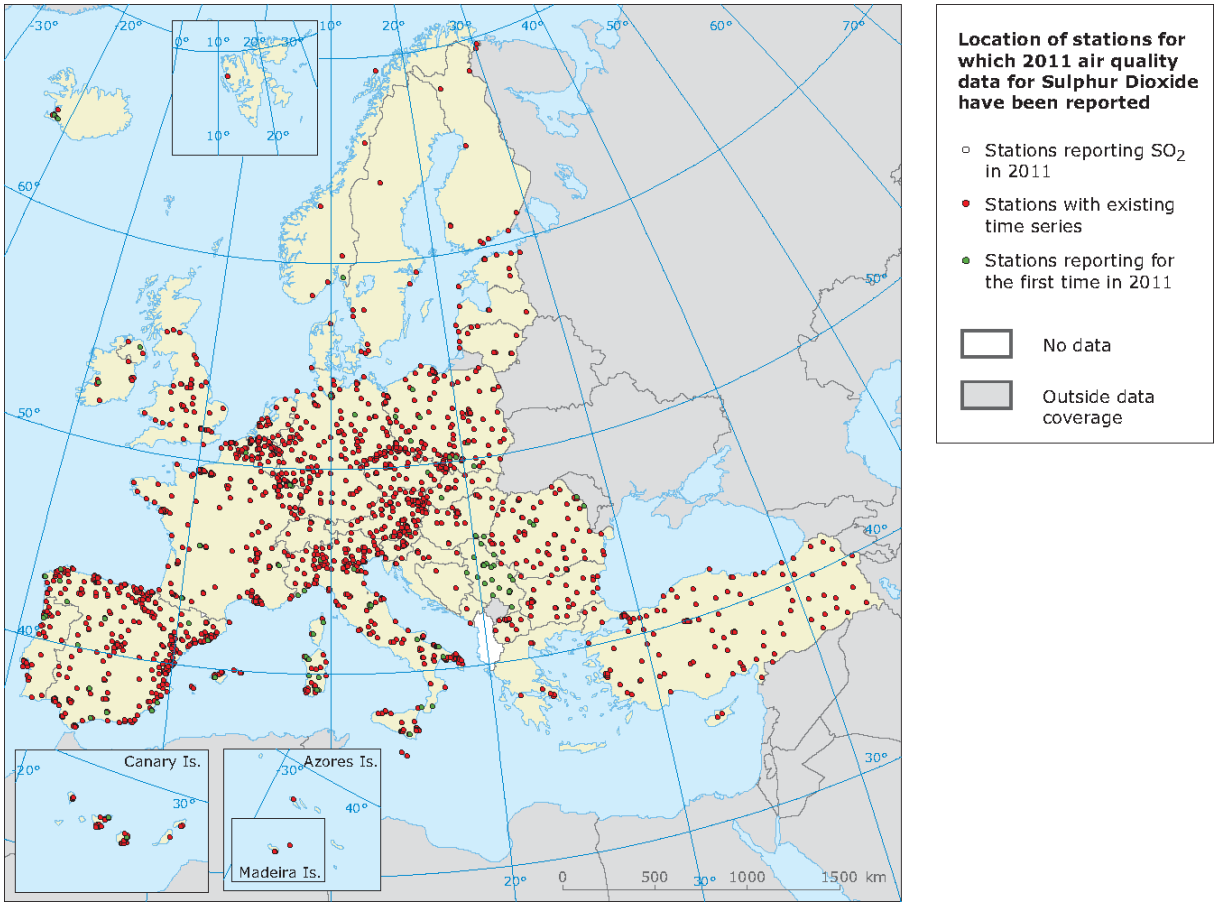

Figure 1 Location of stations for which 2011 air quality data for sulphur dioxide (SO_2) have been reported. The green stations report for the first time (new stations).

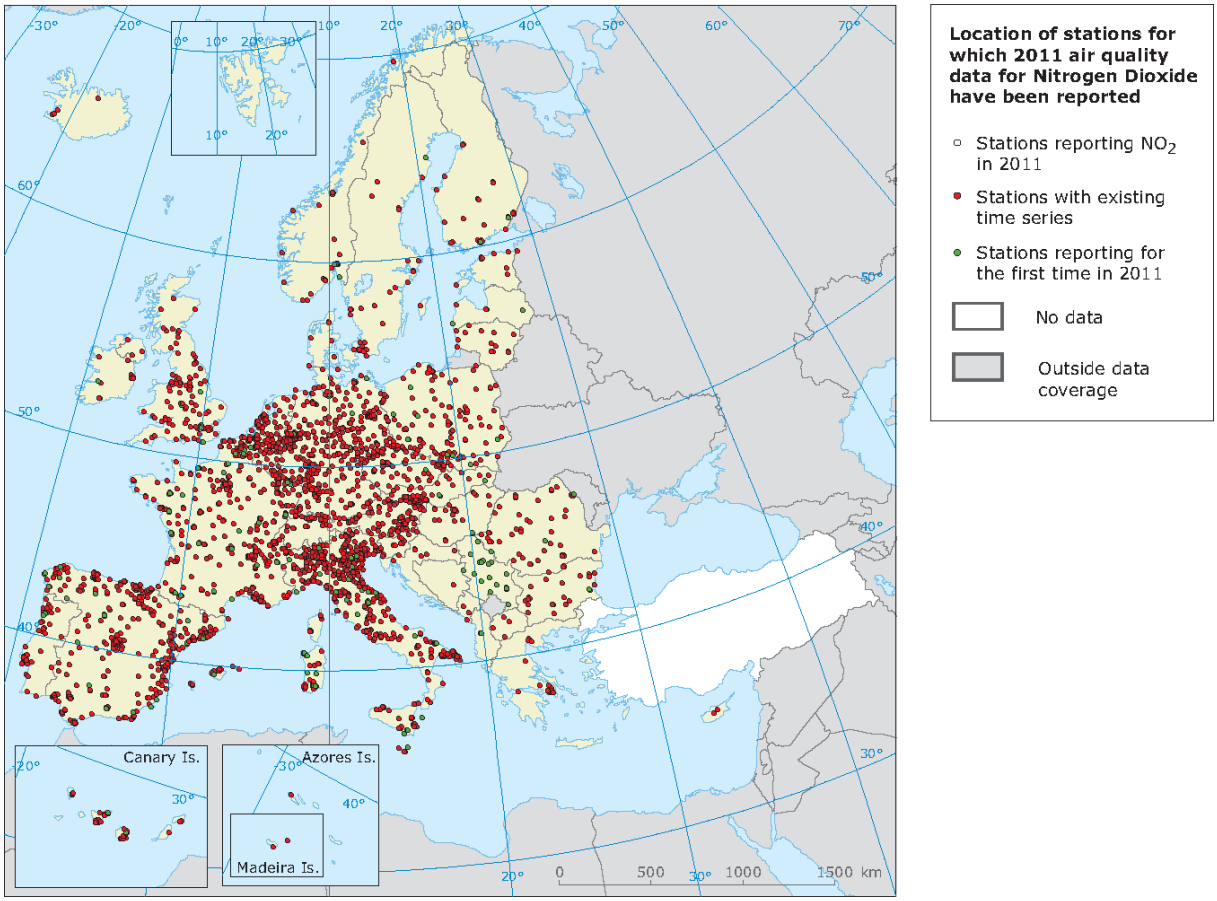

Figure 2 Location of stations for which 2011 air quality data for nitrogen dioxide (NO_2) have been reported. The green stations report for the first time (new stations).

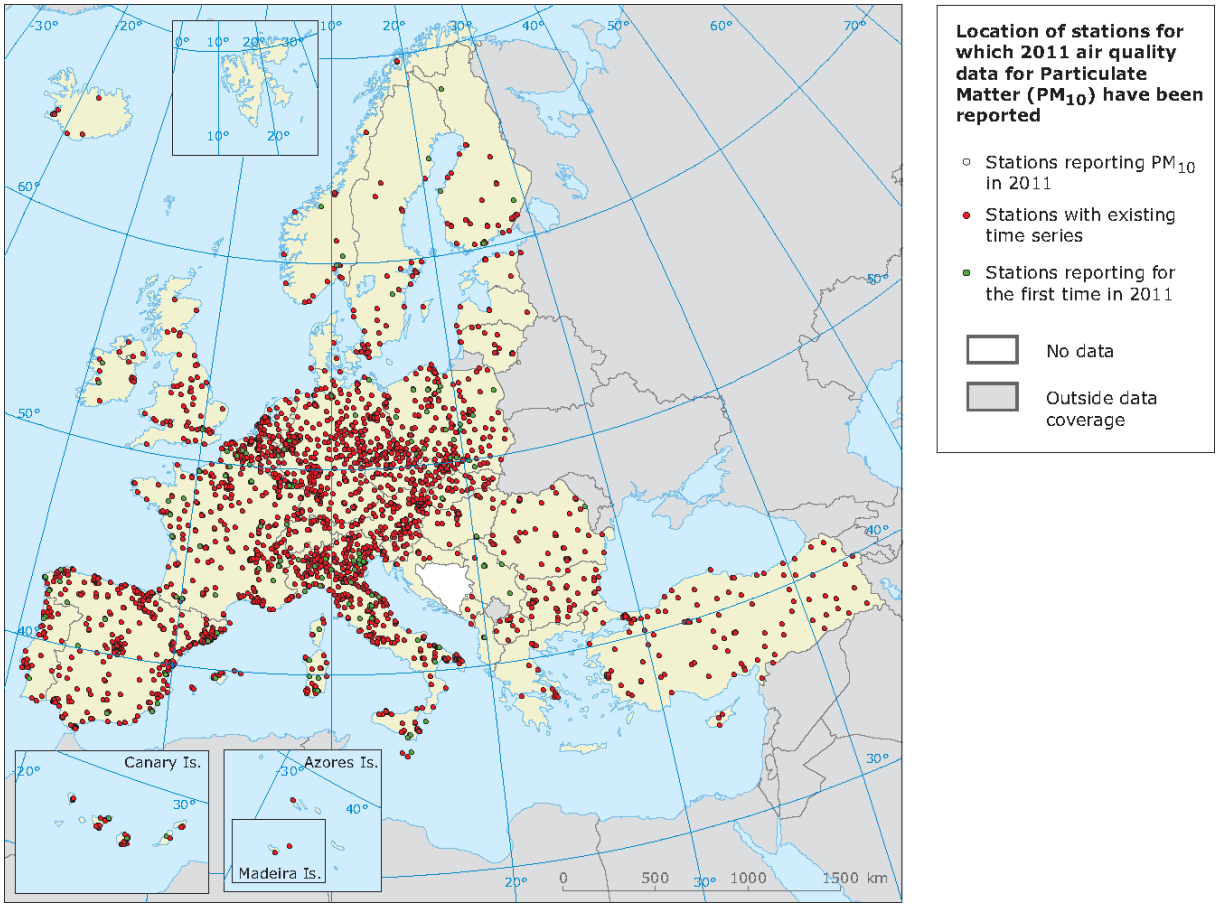

Figure 3 Location of stations for which 2011 air quality data for particulate matter (PM_{10}) have been reported. The green stations report for the first time (new stations).

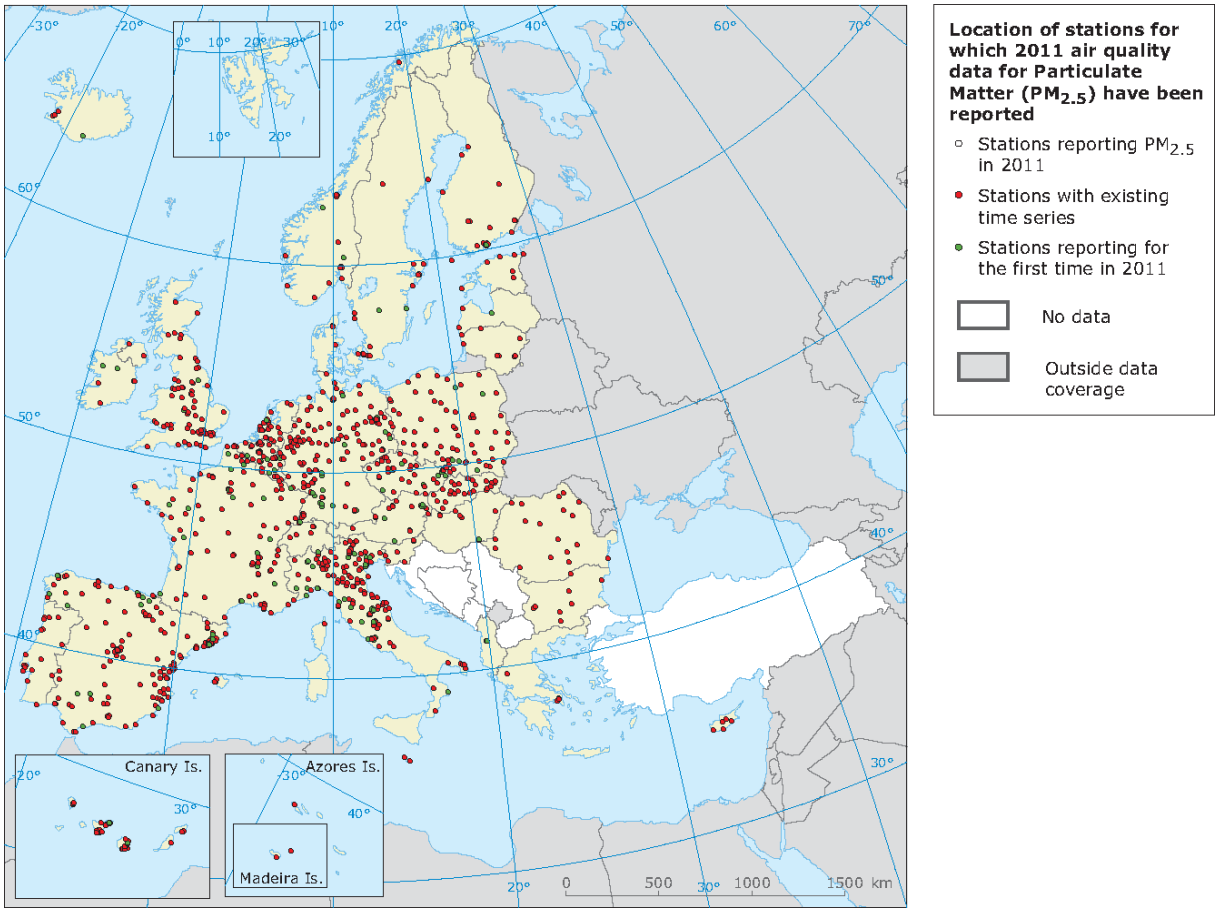

Figure 4 Location of stations for which 2011 air quality data for particulate matter ($PM_{2.5}$) have been reported. The green stations report for the first time (new stations).

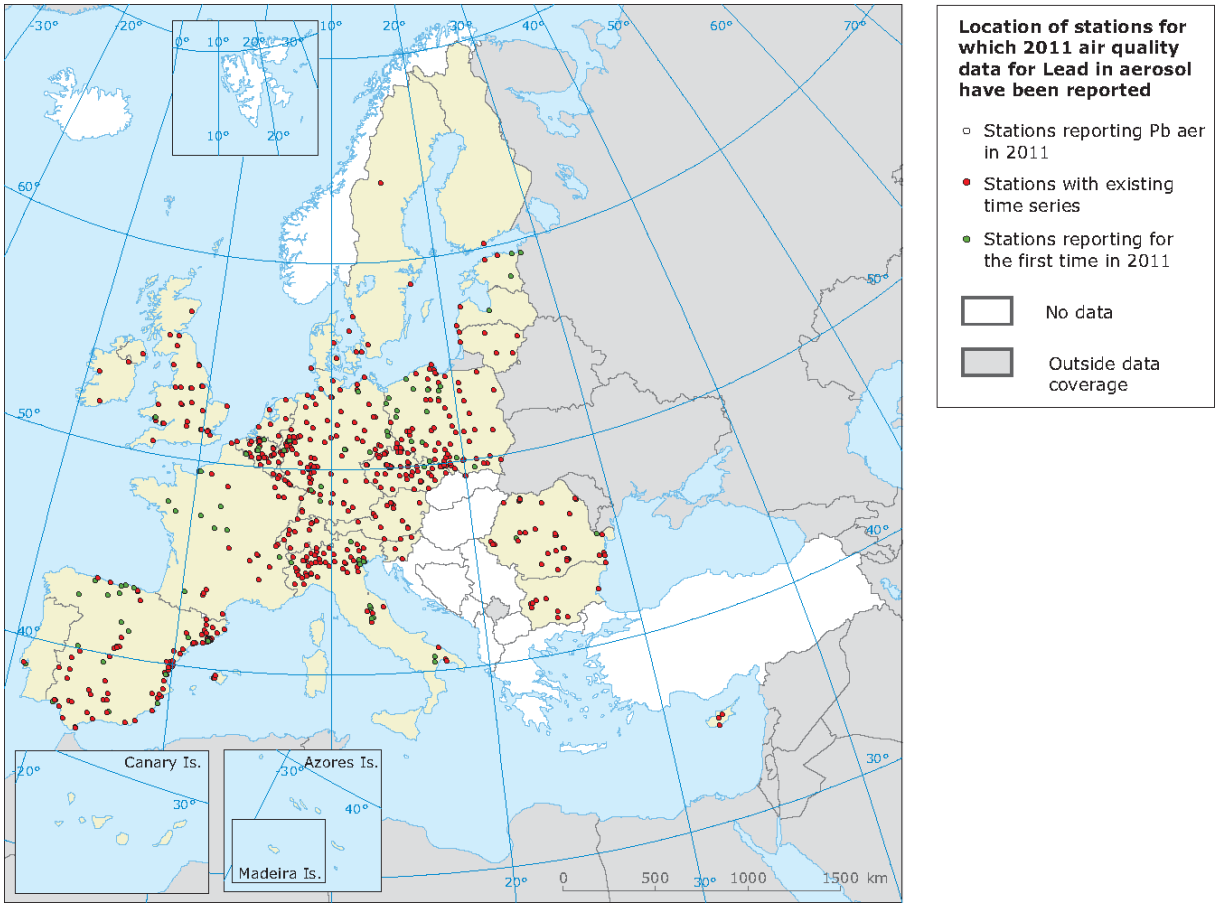

Figure 5 Location of stations for which 2011 air quality data for lead (Pb) have been reported. The green stations report for the first time (new stations).

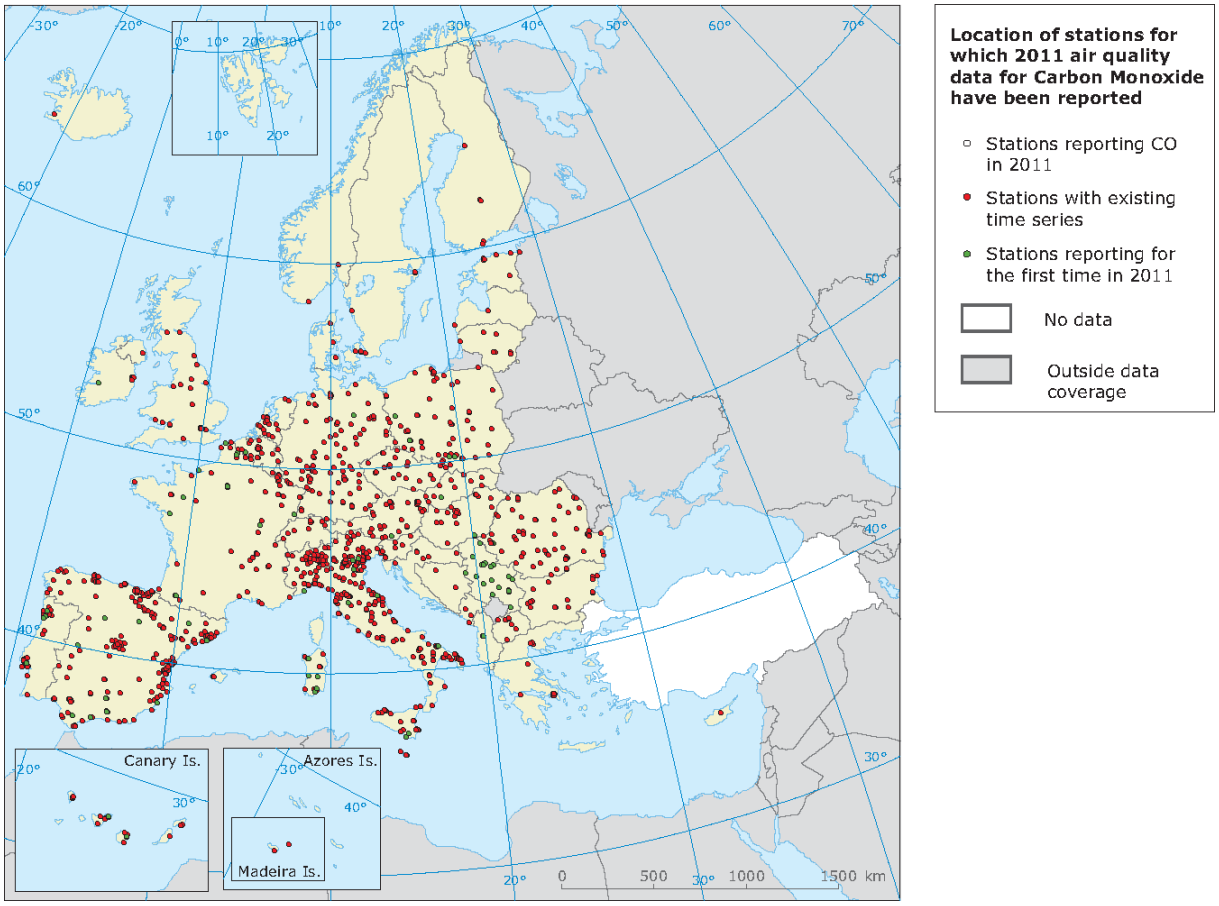

Figure 6 Location of stations for which 2011 air quality data for carbon monoxide (CO) have been reported. The green stations report for the first time (new stations).

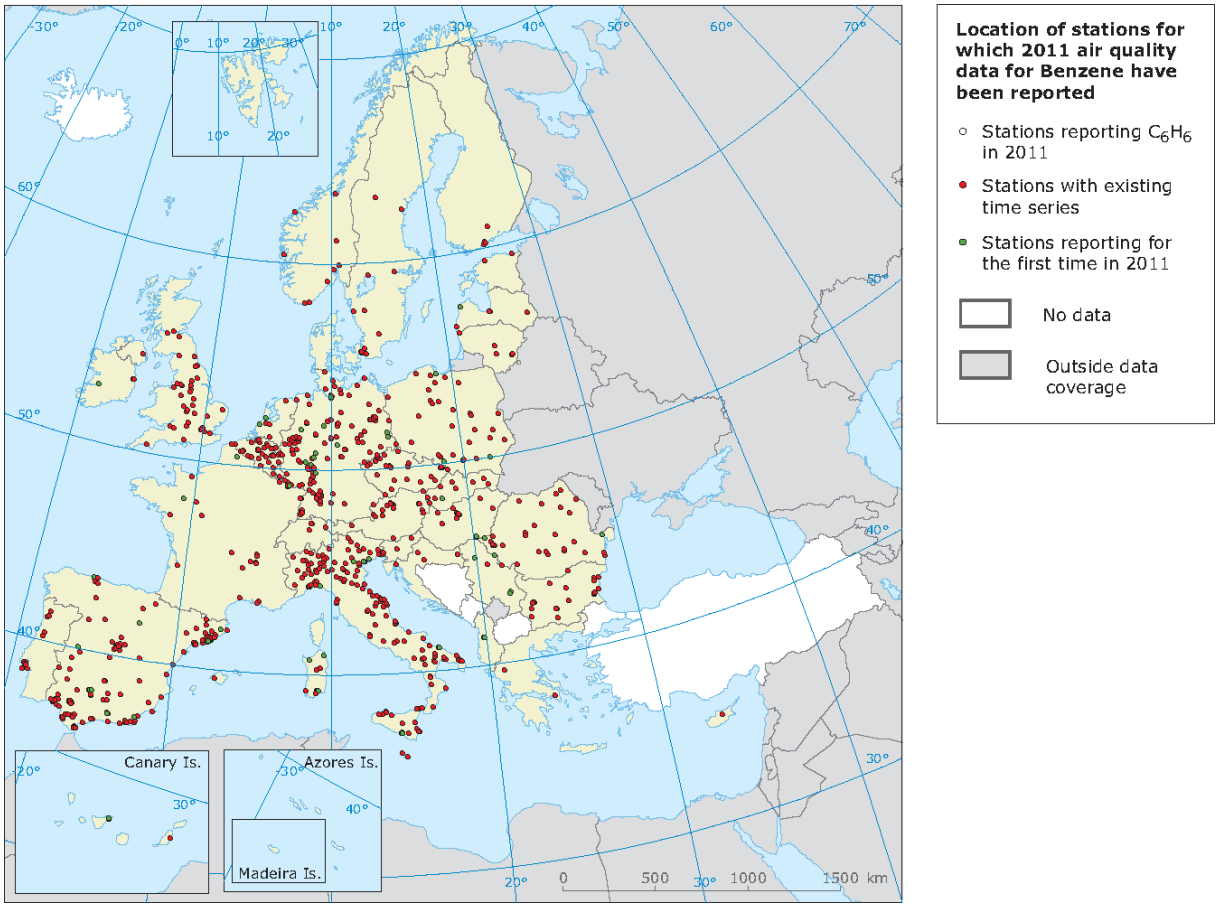

Figure 7 Location of stations for which 2011 air quality data for benzene (C_6H_6) have been reported. The green stations report for the first time (new stations).

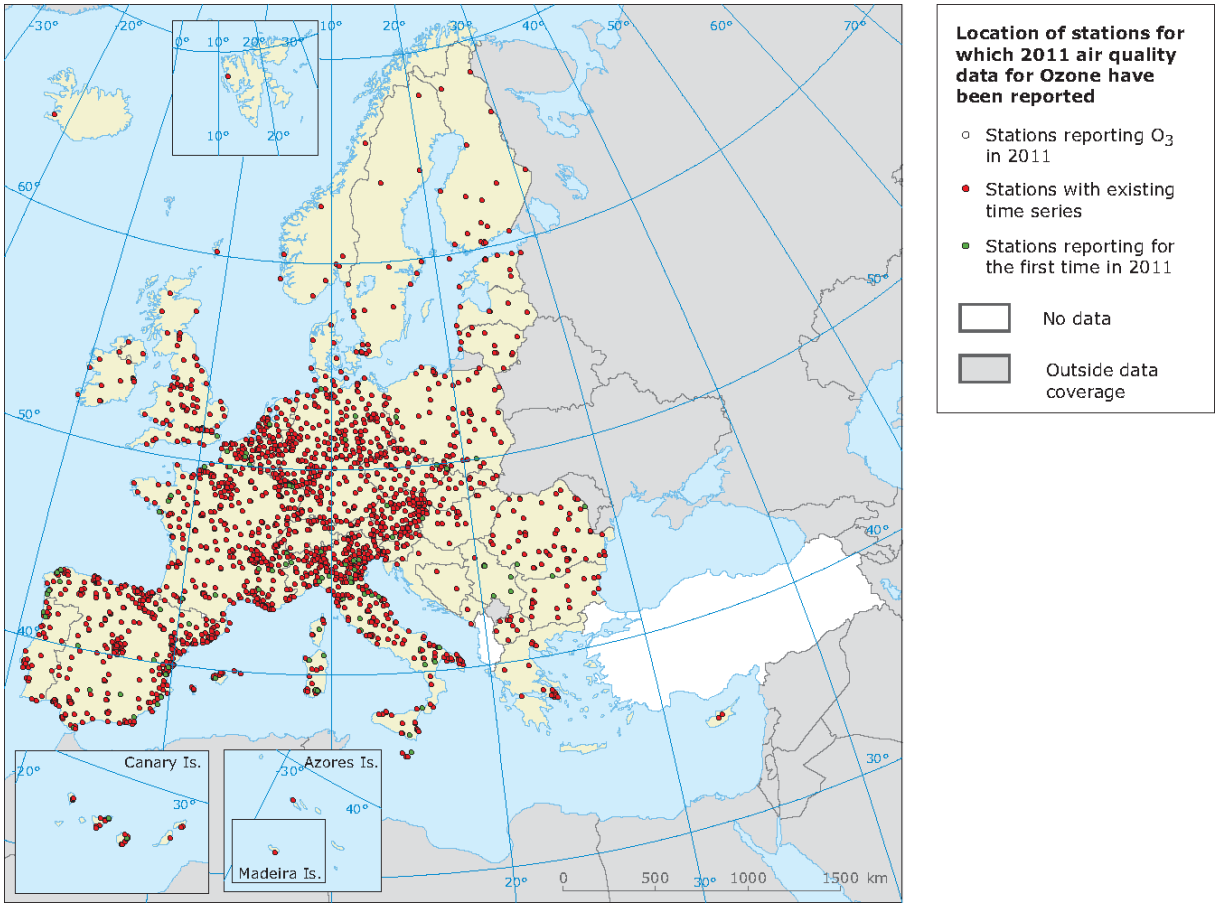

Figure 8 Location of stations for which 2011 air quality data for ozone (O_3) have been reported. The green stations report for the first time (new stations).

1.4. Measurement methods

Figure 9 shows the relative use of different measurement methods for the various components delivered for 2011. The figure shows that reference methods are used to a very large extent for the components ozone (UV photometry, 92%), NO_2 (chemiluminescence, 87%), SO_2 (UV fluorescence, 87%) and CO (infrared spectroscopy, 85%).
For PM_{10} and $PM_{2.5,}$ gravimetry is the reference method. Gravimetric methods are used at 22% of the PM_{10} and 33% of the $PM_{2.5}$ stations. The commonly used automatic instrumental methods TEOM and Beta ray attenuation are used extensively, providing hourly data, while the gravimetric methods give typically only 24-hour averages. These methods should have been compared with the reference method at each measurement configuration and a correction factor should be applied to the data. Countries which deliver a DEM can also report the correction factor. Only a fraction of the PM_{10} stations with Beta ray attenuation and TEOM method have delivered a correction factor, namely 15% and 20% respectively. For the $PM_{2.5}$ stations with Beta Absorption and TEOM method these percentages are 19% and 12% respectively. Additional reporting of correction factors can be found in the Air Quality Questionnaires (form 3). See also (Viana *et al.*, 2011) for an overview of PM10 measurement methods and correction factors in 2009.

For benzene 75% of the stations do report the measurement method used, but most of them incomplete (for example chromatography without further specification). 23% of the stations report gas chromatography followed by mass spectroscopy or flame ionisation for quantification.
For BaP in aerosol 70% of the stations do report the measurement method used, but most of them incomplete (for example chromatography without further specification). 22% of the stations report the reference method (gas chromatography followed by mass spectroscopy) for quantification.
For Pb in aerosol 74% of the stations do report the measurement method used. 67% of the stations report the reference method (atomic absorption spectrometry or inductive coupled plasma mass spectrometryscopy) for quantification.

There is another problem when interpreting measurement results. With respect to the heavy metals and BaP the fraction of particle sizes sampled are not always known. The 2008 AQ Directive prescribes PM_{10}. The percentages of stations reporting that Pb, As, Cd, N and BaP are determined using a PM_{10} sample are 41%, 54%, 53%, 53% and 82% respectively.

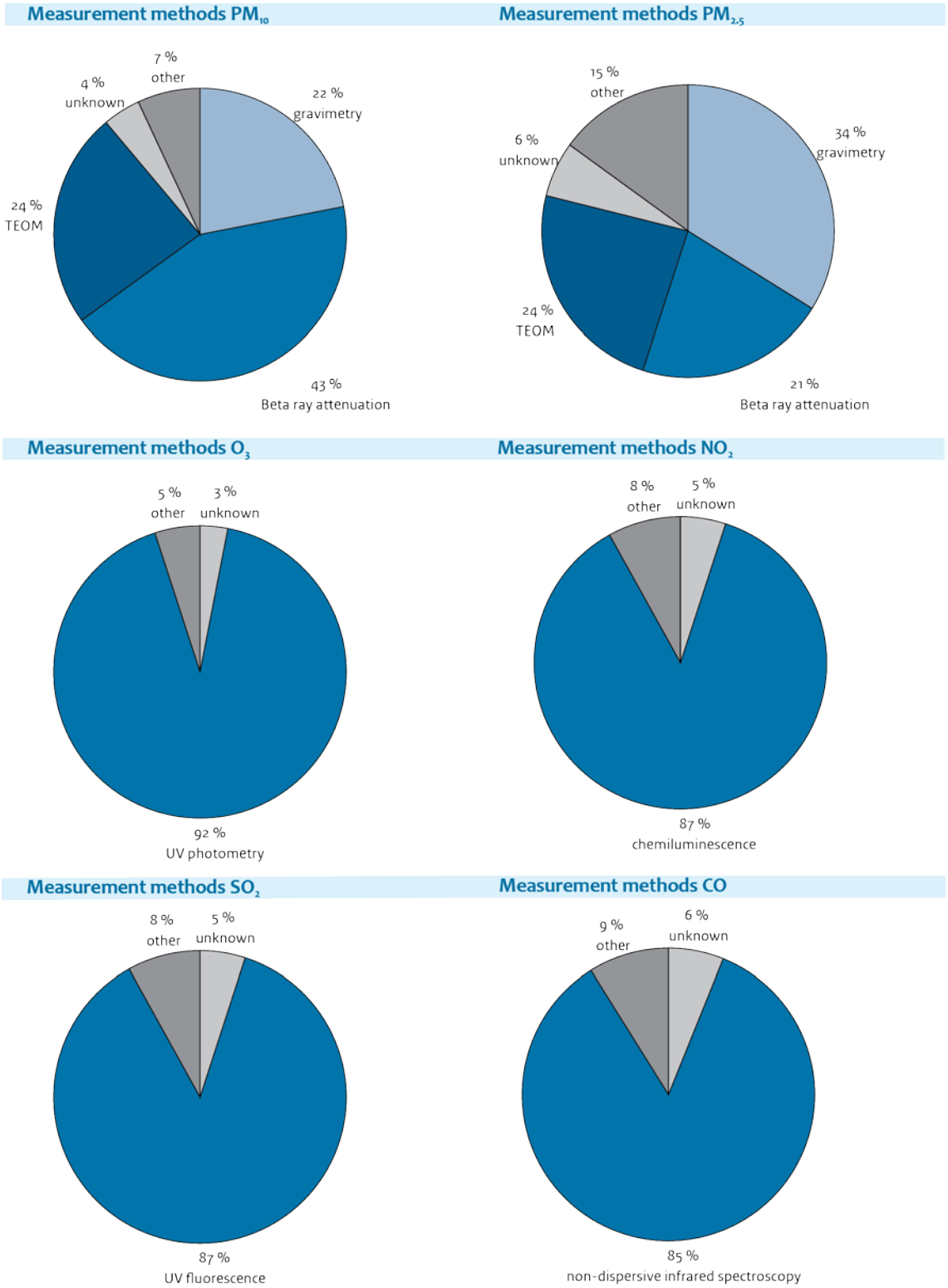

Figure 9 Measurement methods used for PM_{10}, $PM_{2.5}$, O_3, NO_2, SO_2 and CO reported for 2011.

1.5. Total number of stations in AirBase

The total number of stations in AirBase is 8405, from which 7567 stations have measurement data (raw data and statistics). 13 stations have only invalid raw data and have therefore no calculated statistics. 176 stations have only reported statistics; no raw data have been delivered. The 649 stations without data are for instance:

- stations for which meta information has been delivered under the EoI but no measurement data;
- stations for which measurement data will be delivered;
- stations reporting UTD measurement data[14] to the EEA and stations reporting SOR (3rd FWD/DD)[15] data which have not yet delivered for the EoI

Table 3 gives an overview of the number of station in AirBase 7 (with data until 2011); for comparison also the numbers for AirBase 6 (with data until 2010) have been given.

Table 3. Overview number of stations in AirBase 6 and 7

Overview nmbr of stations in AirBase (status:03-04-2013)

Selection of stations	Nr. of stations in AirBase 6	Nr. of stations in AirBase 7
Stations with raw data and statistics	7380	7567
Stations with only statistics	178	176
Stations with only invalid raw data	13	13
Stations without data	397	649
Total stations in AirBase	7968	8405

The EoI should cover at least the stations which are included in the FWD/Questionnaire (EU 2004b). MS are notified when stations and measurement configurations have been reported in UTD, SOR and the FWD/Questionnaire, but are not present in AirBase. They are requested to deliver the meta information of these stations and measurement configurations and the raw data.

[14] http://www.eea.europa.eu/maps/ozone/welcome
[15] http://www.eea.europa.eu/maps/ozone/compare/summer-reporting-under-directive-2002-3-ec

1.6. Historical data, data coverage and time series

The total number of stations with data which have delivered data for 2011 is 4533 (see *Table 4*) which is more than half the number of stations in AirBase (AirBase includes also stations that are no longer operational). This is a decrease of 131 stations compared to the EoI2011.

In the EoI2012 also historical data (2010 or earlier years) have been delivered, see *Table 5*.

Figure 10 gives information on the data coverage of the 2011 stations. The number of stations with data coverage >0% (all operational 2011 stations) have been compared with the number of stations with >=75% and >=90% data coverage[16]. Table D also provides information on data coverage for selected pollutants, see "Information on time series in AirBase": http://acm.eionet.europa.eu/databases/airbase/eoi_tables/eoi2012/index_html

Long-term measurement series provide valuable information for determining, for example, the effect of abatement measures and trend analysis. Keeping in mind that AirBase became operational in 1997, the average length of the time series in AirBase can also be found in table D. Note that the length of the time series in years in table D is calculated regardless of the data coverage in a year. The calculation is also based on any averaging time. If there is a gap of one or more years, the maximum length of time series is taken. For the average length of time series all stations available in AirBase have been included.

The number of stations with continuous time series is visualized in *Figure 11* for several components.

[16] The data quality objectives as laid down in the Directives 2008/50/EC and 2004/170/EC require, in general, a data coverage of 90%. For continuous measurements in the assessments presented here (chapter 2) a criterion of 75% data coverage is applied.

Table 4 Summary of periods and number of stations for which data have been delivered.

Country	Air quality reporting Start/end year [1]	Number of stations for which data have been delivered for at least one year in the whole period [1]	Number of stations for which 2010 data have been delivered in the EoI2011 [1]	Number of stations for which 2011 data have been delivered in the EoI2012 [1]
EU-27 countries				
AUSTRIA	1981-2011	265	195	187
BELGIUM	1985-2011	386	243	224
BULGARIA	1998-2011	42	42	40
CYPRUS	1993-2011	9	6	6
CZECH REPUBLIC	1992-2011	196	172	171
DENMARK	1976-2011	42	15	14
ESTONIA	1997-2011	11	9	9
FINLAND	1990-2011	109	59	66
FRANCE	1976-2011	1110	678	687
GERMANY	1976-2011	1247	660	634
GREECE	1983-2011	37	28	28
HUNGARY	1996-2011	50	36	37
IRELAND	1973-2011	108	28	28
ITALY	1976-2011	1144	705	648
LATVIA	1997-2011	23	11	15
LITHUANIA	1997-2011	25	18	18
LUXEMBOURG	1976-2011	14	8	8
MALTA	2002-2011	8	5	5
NETHERLANDS	1976-2011	99	80	79
POLAND	1997-2011	538	274	241
PORTUGAL	1986-2011	107	72	69
ROMANIA	1999-2011	178	132	122
SLOVAKIA	1995-2011	60	38	37
SLOVENIA	1996-2011	34	30	24
SPAIN	1986-2011	859	600	617
SWEDEN	1985-2011	87	57	60
UNITED KINGDOM	1969-2011	572	183	184
Total		*7360*	*4384*	*4258*
Non-EU-27 countries				
ALBANIA	2011-2011	2	3	2
BOSNIA - HERZEGOVINA	1985-2011	21	8	4
CROATIA	2004-2011	8	8	8
ICELAND	1993-2011	24	13	13
LIECHTENSTEIN	2004-2011	2	1	1
MACEDONIA, FYRO [2]	1997-2011	46	24	23
MONTENEGRO	2008-2011	4	4	4
NORWAY	1994-2011	64	49	47
SERBIA	2002-2011	48	20	26
SWITZERLAND	1991-2011	47	33	31
TURKEY	2007-2011	117	117	116
Total		*383*	*280*	*275*
Total EU-27 + non-EU-27 countries		*7743*	*4664*	*4533*

1) Irrespective of the component(s) measured
2) FYRO= Former Yugoslavian Republic Of

Table 5 Number of stations delivering historical data (2010 or earlier years) in the EoI 2012

Country	Number of stations for which 2010 data have been delivered in the EoI2012 [1)]	Number of stations for which <2010 data have been delivered in the EoI2012 [1)]
EU-27 countries		
AUSTRIA	13	12
CYPRUS	1	0
CZECH REPUBLIC	73	78
DENMARK	1	0
FINLAND	23	2
FRANCE	19	0
IRELAND	5	0
NETHERLANDS	8	8
PORTUGAL	7	0
SLOVENIA	1	0
SWEDEN	6	6
UNITED KINGDOM	7	1
Total	*164*	*107*
Non-EU-27 countries		
NORWAY	1	1
Total	*1*	*1*
Total EU-27 + non-EU-27 countries	*165*	*108*

1) Irrespective of the component(s) measured

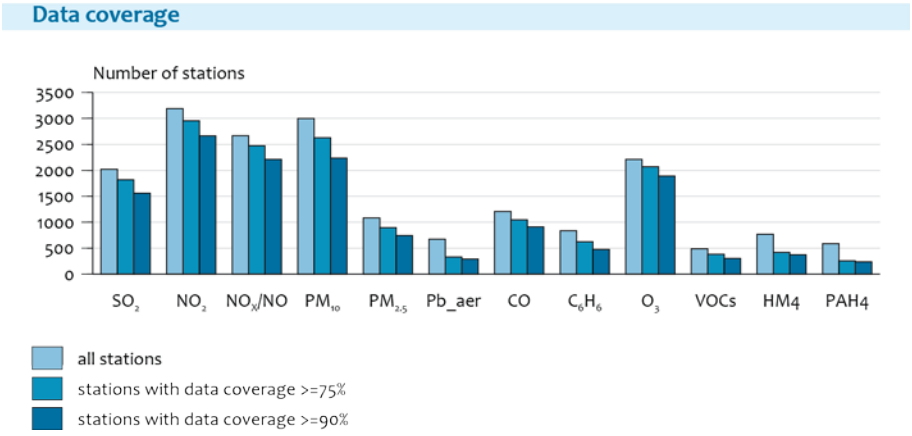

Figure 10 Number of stations with 2011 data coverage >0% (with data), >=75% and >=90%. Data coverage is based on daily averages for SO_2, NO_2, NO_x/NO, PM_{10}, $PM_{2.5}$, Pb_aer, benzene, VOC, HM4 and PAH4 and based on daily running 8h maximum for CO and O_3

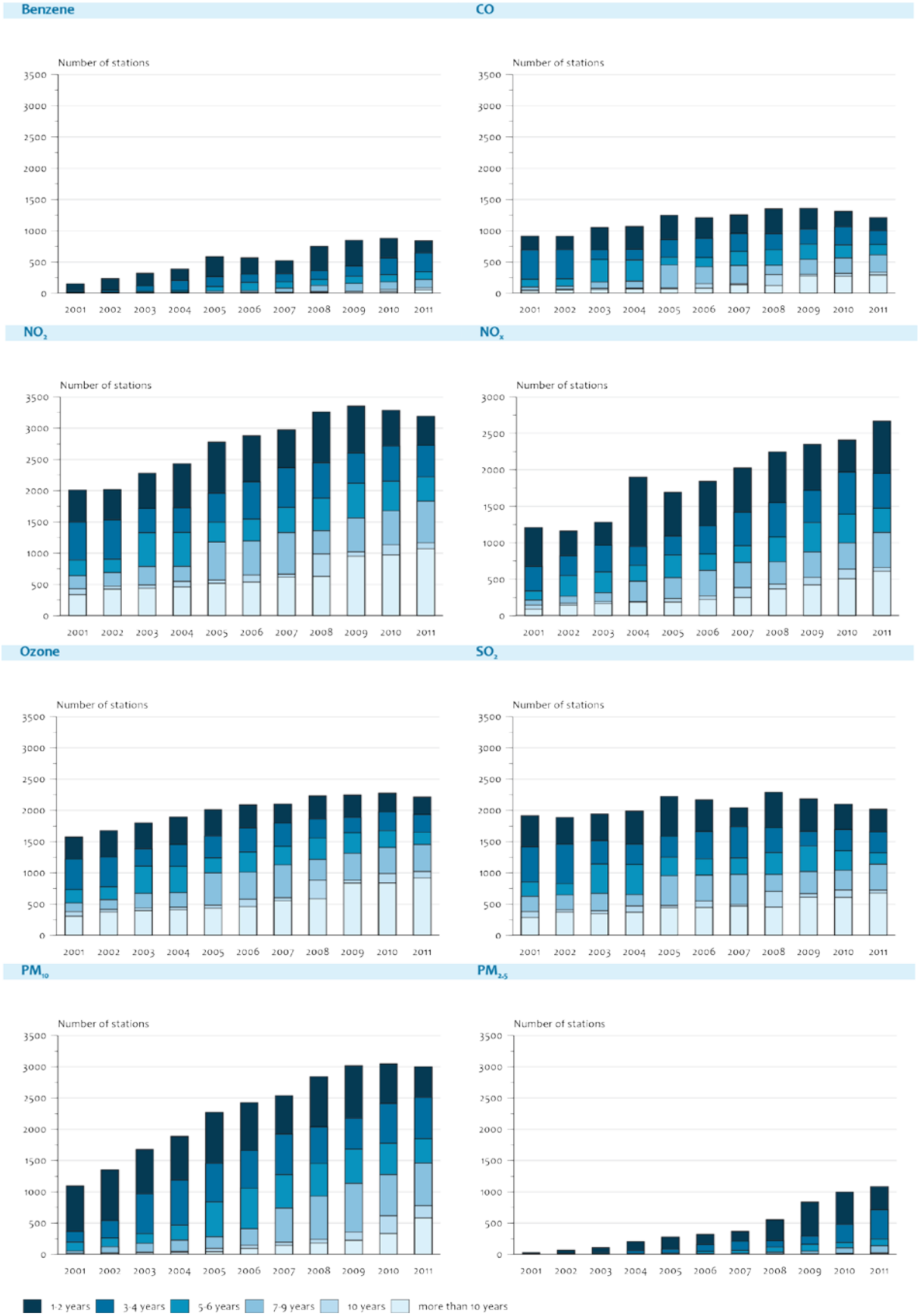

Figure 11 Number of stations with time series of 1-2, 3-4, 5-6, 7-9, 10 and more than 10 year ending in the year on the x-axis for several components.

2. CONCLUSIONS

A total of 38 countries, including all 27 EU Member States, have provided air quality data for 2011. Measurement data from a total of 4533 stations have been delivered in the EoI2012. This is a small decrease in comparison with the EoI2011.
Increases are seen in the number of stations reporting NO_x/NO (10%), $PM_{2.5}$ (9%), Pb_aer (2%), VOC- (5%), $PM_{2.5}$_spec (60%), HM4 (1%) and PAH4 (3%).

In the EoI2012 letter (accompanying the request sent to the Member States in 2012 for submitting 2011 air quality data) mailed to all the data suppliers, the Member States were requested to submit at least two of the three oxidised nitrogen components (NO_2, NO, NO_x). The difference between the number of stations for which NO_2 has been reported and the number of stations for which NO (or NO_x) has been reported is smaller for the 2011 data then for the 2010 data. In AirBase, NO_x values have been derived by ETC/ACM for stations where NO and NO_2 values have been reported, but no NO_x values.

Nearly all countries delivered the data on time (before 1st of October 2012). ETC/ACM has produced QA/QC country feedback reports (see also (Mol, 2012)). The response to these reports was very good; almost all countries replied to this response within the deadline. The quality of the meta information, measurement data but also the derived information (statistics, exceedances) in AirBase has been further improved.

3. LIST OF ABBREVIATIONS

AOT40	ozone concentrations Accumulated dose Over a Threshold of 40 ppb
AQ	Air Quality
AQD	Air Quality Directive
CDR	Central Data Repository
DD	Daughter Directives
4DD	Fourth Daughter Directive 2004/107/EC
DEM	Data Exchange Module
DG ENV	Directorate-General Environment
EEA	European Environment Agency
EFTA	European Free Trade Association
EoI	Exchange of Information
ETC/ACM	European Topic Centre on Air Pollution and Climate Change Mitigation
EU	European Union
EU-27	The 27 EU Member States
FWD	Air Quality Framework Directive on ambient air quality assessment and Management Directive 96/62/EC
IPR	Implementing PRovisions of the Air Quality Directive 2008/50/EC
LAT	Lower Assessment Threshold
MS	Member State(s)
NUTS	Nomenclature des Unités Territoriales Statistiques
QA/QC	Quality Assurance & Quality Control
SOR	Summer Ozone Reporting
SOMO35	Sum of Ozone Means Over 35 ppb
TEOM	Tapered Element Oscillating Microbalance
UTD	Up To Date

List of components and component groups

As	arsenic
B(a)P	benzo(a)pyrene
C_6H_6	benzene
Cd	cadmium
CO	carbon monoxide
Hg	mercury
HM	Heavy Metals
HM4	Heavy Metals in the 4th DD (see list in Annex D)
Ni	nickel
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NO_x/NO	Delivered NO_x and, if no NO_x data available, NO_2 + NO
O_3	ozone
PAH	Polycyclic Aromatic Hydrocarbons
PAH4	Polycyclic Aromatic Hydrocarbons in the 4th DD (see list in Annex D)
Pb	lead
Pb_aer	lead in aerosol (see list in Annex D)
$PM_{2.5}$	particulate matter with particle diameter 2.5 µm or less
$PM_{2.5}$_spec	$PM_{2.5}$ speciation concentrations (see list in Annex D)
PM_{10}	particulate matter with particle diameter 10 µm or less
SO_2	sulphur dioxide
VOC	Volatile Organic Compounds (see list in Annex D)
VOC-	Volatile Organic Compounds minus benzene

4. REFERENCES

EEA (2013) Air Quality in Europe – 2013 report. In preparation.

EU (1997): Council Decision of 27 January 1997 establishing a reciprocal exchange of information and data from networks and individual stations measuring ambient air pollution within the Member States (Exchange of Information (97/101/EC)). Official Journal L 035, 05/02/1997, pp. 14-22. See http://ec.europa.eu/environment/air/quality/legislation/reporting.htm

EU (2001a): Commission Decision of 17 October 2001 amending the Annexes to Council Decision 97/101/EC establishing a reciprocal exchange of information and data from networks and individual stations measuring ambient air pollution within the Member States (2001/752/EC). Official Journal L 282, 26/10/2001, pp. 69–76. See http://ec.europa.eu/environment/air/quality/legislation/reporting.htm

EU (2001b): Corrigendum to Commission Decision 2001/752/EC of 17 October 2001 amending the Annexes to Council Decision 97/101/EC establishing a reciprocal exchange of information and data from networks and individual stations measuring ambient air pollution within the Member States. Official Journal L 334, 18/12/2001, pp. 35. See http://acm.eionet.europa.eu/announcements/country_tools/aq/aq-dem/docs/2001_752_EC_Corrigendum.pdf?i=0

EU (2004a): Directive 2004/107/EC of the European Parliament and the Council of 15 December 2004 relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air (fourth Daughter Directive (2004/107/EC)). Official Journal L 23, 26/01/2005, pp. 3–16. See http://ec.europa.eu/environment/air/legis.htm

EU (2004b): Directive 2004/461/EC of the European Parliament and the Council laying down a AQ questionnaire to be used for annual reporting on ambient air quality assessment under Council Directives 96/62/EC and 1999/30/EC and under Directives 2000/69/EC and 2002/3/EC of the European Parliament and of the Council. See http://ec.europa.eu/environment/air/legis.htm

EU (2008): Directive 2008/50/EC of the European Parliament and the Council of 21 May 2008 on ambient air quality and cleaner air for Europe. Official Journal L 152, 11/06/2008, pp. 1–44. See http://ec.europa.eu/environment/air/quality/legislation/existing_leg.htm

EU (2011): Directive 2011/850/EC of the European Parliament and the Council of 17 December 2011 laying down rules for Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council as regards the reciprocal exchange of information and reporting on ambient air quality. Official Journal L 335, 17/12/2011, pp. 86–106. See http://ec.europa.eu/environment/air/quality/legislation/existing_leg.htm

EU (2013): Commission Implementing Decision laying down rules for Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council as regards the reciprocal exchange of information and reporting on ambient air (Decision 2011/850/EU). Draft version of 13 February 2013.

Garber W., Colosio J., Grittner S., Larssen S., Rasse D., Schneider J., Houssiau M. (2001): Guidance on the Annexes to Decision 97/101/EC on Exchange of Information as revised by Decision 2002/752/EC. European Commission, DG Environment, Brussels. http://ec.europa.eu/environment/air/quality/legislation/reporting.htm

Mol, W.J.A., Leeuw F.A.A.M. de (2005): AirBase: A Valuable Tool in Air Quality Assessments in: The Proceedings of the 5th International Conference on Urban Air Quality, Valencia Spain 29-31 March 2005, Editors R.S. Sokhi, M.M. Millán and N. Moussiopoulos.

Mol, W.J.A. (2012): Quality checks on air quality data in AirBase and the EoI data in 2012. ETC/ACM Working Paper December 2012. Available at http://acm.eionet.europa.eu/databases/airbase/ETCACM_WP_2012_Quality_checks_EoI2012_AirBase.pdf

Viana, M. *et al.* (2011): PM10 measurement methods and correction factors: 2009 status report. ETC/ACM Technical Paper 2011/21. Available at http://acm.eionet.europa.eu/reports/ETCACM_TP_2011_21_PM10Equivalence

Annex A. Exchange of Information requirements

The MS of the EU should, according to Annex II of the Council Decision on the reciprocal exchange of information, report certain types of meta information (EU, 2001a). Part of the information, as mentioned in Annex II, is mandatory (*Table A1*). The other information should be delivered 'to the extent possible' and 'as much as feasible' (*Table A2)*.

Table A.1 Overview of mandatory meta information to be delivered under the EoI

Item [a]	Description
I.1.	Name of the network
I.4.1.	Name of the body responsible for network management
I.4.2.	Name of person responsible
I.4.3.	Address
I.4.4.	Telephone and fax numbers
I.5.	Time reference basis
II.1.1.	Name of the station
II.1.4.	Station code given under the present decision and to be provided by the Commission
II.1.8.	Geographical co-ordinates
II.1.10.	Pollutants measured
II.1.11.	Meteorological parameters measured
II.2.1.	Type of area

(a) Numbers according to Annex II of the EoI (EU, 2001a)

Table A.2. Overview of non-mandatory meta information to be delivered under the EoI

Item [a]	Description
I.2.	Abbreviation (of the network)
I.3.	Type of networks
I.4.5.	E-mail (of the body responsible for the network)
I.4.6.	Website address
II.1.2.	Name of the town/city of location (of the station)
II.1.3.	National and/or local reference number or code
II.1.5.	Name of technical body responsible for the station
II.1.6.	Bodies or programmes to which data are reported
II.1.7.	Monitoring objectives
II.1.9.	NUTS level IV
II.1.12	Other relevant information
II.2.2.	Type of station in relation to dominant emission sources
II.2.3.	Additional information about the station
III.1.1.	Name (of measurement equipment)
III.1.2.	Analytical principle or measurement method
III.2.1.	Location of sampling point
III.2.2	Height of sampling point
III.2.3	Result-integrating time
III.2.4	Sampling time

(a) Numbers according to the Annex II of the EoI (EU, 2001a).

Table A.3 Overview of mandatory pollutants to be delivered under the EoI

EoI nr.	Formula	Name of pollutant	Units of measurement	Average over
1	SO_2	Sulphur dioxide	µg/m^3	1 h
2	NO_2	Nitrogen dioxide	µg/m^3	1 h
3	PM_{10}	Particulate matter < 10 µm	µg/m^3	24 h
4	$PM_{2.5}$	Particulate matter < 2.5 µm	µg/m^3	24 h
5	SPM	Total suspended particulates	µg/m^3	24 h
6	Pb	Lead	µg/m^3	24 h
7	O_3	Ozone	µg/m^3	1 h
8	C_6H_6	Benzene	µg/m^3	24 h
9	CO	Carbon monoxide	mg/m^3	1 h
10	Cd	Cadmium	ng/m^3	24 h
11	As	Arsenic	ng/m^3	24 h
12	Ni	Nickel	ng/m^3	24 h
13	Hg	Mercury	ng/m^3	24 h
14	BS	Black smoke	µg/m^3	24 h
15	NO_X	Nitrogen oxides	µg NO_2/m^3	1 h

Table A.4 Overview of other pollutants to be delivered under the EoI if available

EoI nr.	Formula	Name of pollutant	Units of measurement	Average over
16	$C2H_6$	Ethane	$\mu g/m^3$	24 h
17	$H_2C=CH_2$	Ethene (Ethylene)	$\mu g/m^3$	24 h
18	HC=CH	Ethyne (Acetylene)	$\mu g/m^3$	24 h
19	$H_3C-CH_2-CH_3$	Propane	$\mu g/m^3$	24 h
20	$CH_2=CH-CH_3$	Propene	$\mu g/m^3$	24 h
21	$H_3C-CH_2-CH_2-CH_3$	n-Butane	$\mu g/m^3$	24 h
22	$H_3C-CH(CH_3)_2$	i-Butane	$\mu g/m^3$	24 h
23	$H_2C=CH-CH_2-CH_3$	1-Butene	$\mu g/m^3$	24 h
24	$H_3C-CH=CH-CH_3$	trans-2-Butene	$\mu g/m^3$	24 h
25	$H_3C-CH=CH-CH_3$	cis-2-Butene	$\mu g/m^3$	24 h
26	$CH_2=CH-CH=CH_2$	1.3 Butadiene	$\mu g/m^3$	24 h
27	$H_3C-(CH_2)_3-CH_3$	n-Pentane	$\mu g/m^3$	24 h
28	$H_3C-CH_2-CH(CH_3)_2$	i-Pentane	$\mu g/m^3$	24 h
29	$H_2C=CH-CH_2-CH_2-CH_3$	1-Pentene	$\mu g/m^3$	24 h
30	$H_3C-HC=CH-CH_2-CH_3$	2-Pentenes	$\mu g/m^3$	24 h
31	$CH_2=CH-C(CH_3)=CH_2$	Isoprene	$\mu g/m^3$	24 h
32	C_6H_{14}	n-Hexane	$\mu g/m^3$	24 h
33	$(CH_3)_2-CH-CH_2-CH_2-CH_3$	i-Hexane	$\mu g/m^3$	24 h
34	C_7H_{16}	n-Heptane	$\mu g/m^3$	24 h
35	C_8H_{18}	n-Octane	$\mu g/m^3$	24 h
36	$(CH_3)_3-C-CH_2-CH-(CH_3)_2$	i-Octane	$\mu g/m^3$	24 h
37	$C_6H_5-CH_3$	Toluene	$\mu g/m^3$	24 h
38	$C_6H_5-C_2H_5$	Ethyl benzene	$\mu g/m^3$	24 h
39	m,p-$C_6H_4(CH_3)_2$	m,p-Xylene	$\mu g/m^3$	24 h
40	o-$C_6H_4-(CH_3)_2$	o-Xylene	$\mu g/m^3$	24 h
41	$C_6H_3-(CH_3)_3$	1,2,4-Trimethylbenzene	$\mu g/m^3$	24 h
42	$C_6H_3(CH_3)_3$	1,2,3-Trimethylbenzene	$\mu g/m^3$	24 h
43	$C_6H_3(CH_3)_3$	1,3,5-Trimethylbenzene	$\mu g/m^3$	24 h
44	HCHO	Formaldehyde	$\mu g/m^3$	1 h
45	THC (NM)	Total non-methane hydrocarbons	$\mu g\ C/m^3$	24 h
46	SA	Strong acidity	$\mu g\ SO_2/m^3$	24 h
47	PM1	Particulate matter < 1 µm	$\mu g/m^3$	24 h
48	CH_4	Methane	$\mu g/m^3$	24 h
49	Cr	Chromium	ng/m3	24 h
50	Mn	Manganese	ng/m3	24 h
51	H_2S	Hydrogen sulphide	$\mu g/m^3$	24 h
52	CS_2	Carbon disulphide	$\mu g/m^3$	1 h
53	$C_6H_5-CH=CH_2$	Styrene	$\mu g/m^3$	24 h
54	$CH_2=CH-CN$	Acrylonitrile	$\mu g/m^3$	24 h
55	$CHCl=CCl_2$	Trichloroethylene	$\mu g/m^3$	24 h
56	C_2Cl_4	Tetrachloroethylene	$\mu g/m^3$	24 h
57	CH_2Cl_2	Dichloromethane	$\mu g/m^3$	24 h
58	BaP	Benzo(a)pyrene	$\mu g/m^3$	24 h
59	VC	Vinyl chloride	$\mu g/m^3$	24 h
60	PAN	Peroxyacetyl nitrate	$\mu g/m^3$	1 h
61	NH_3	Ammonia	$\mu g/m^3$	24 h
62	N-DEP	Wet nitrogen deposition	mg N/(m^2*month)	1 month
63	S-DEP	Wet sulphur deposition	mg S/(m^2*month)	1 month

Annex B. Aggregation of data and calculation of statistics and NO_x values in AIRBASE

1. Hourly and daily values

Aggregation of data

The air quality statistics in AirBase are based on *hourly values*, *daily (24-hour) average values*, and *daily 8-hour maximum values*. However, most of the reported measurement data are in hourly time episodes. To obtain the daily and 8-hour based statistical parameters the hourly values (if available) are aggregated to derive daily and 8-hourly values. If a country reports both hourly and daily values, the reported daily values will be ignored. The calculated daily values will be used instead for calculating the statistics. If 3-hourly data are delivered, these data are aggregated in daily values.

For the aggregation of hourly data to longer averaging periods (8 hourly, daily) a minimum data capture of 75% is required to calculate a valid aggregated value:

- a *daily averaged* (24-hourly) concentration is calculated when at least 18 valid hourly values are available
- a *8-hourly averaged* concentration is calculated when at least 6 valid hourly values are available
- a *maximum daily 8-hour mean* is calculated when at least 18 valid running 8-hour averages per day are available

For the aggregation of 3hourly data to daily values we have also the 75% data capture rule:

- a *daily averaged* concentration is calculated when at least 6 valid 3-hourly values are available

Statistics calculation on annual basis

The following types of annual statistics are calculated depending on the component:

- *General* concentration statistic: annual mean, 50, 95, 98 percentiles and maximum (only SO_2 also 99.9 percentile based on hourly values).
- *Exceedances*: hours/days with concentration > y µg/m^3 (with y = limit or threshold value) and the k^{th} highest value
- *AOT40*: ozone concentrations accumulated dose over a threshold of 40 ppb (AOT40 definition see below)
- *SOMO35*: ozone concentrations accumulated dose over a threshold of 35 ppb (SOMO35 definition see below)

The annual statistical parameters of the table are routinely calculated and stored in AirBase. The statistical parameters are calculated irrespective of the proportion of valid data (data capture) with one exception: all hourly and daily statistics which are based on one day or less are excluded. So statistics with a data coverage lower than 0.275% aren't calculated.

Component	Parameter based on		
	1 hour values	daily values	Maximum daily 8-hour mean
Sulphur dioxide (SO_2)	• annual mean • 50 percentile • 95 percentile • 98 percentile • 99.9 percentile • maximum • hours with c > 350 μg/m^3 • 25th highest value	• annual mean • 50 percentile • 95 percentile • 98 percentile • maximum • days with c > 125 μg/m^3 • 4th highest value	
Nitrogen dioxide (NO_2)	• annual mean • 50 percentile • 95 percentile • 98 percentile • maximum • hours c > 200 μg/m^3 • 19th highest value	• annual mean • 50 percentile • 95 percentile • 98 percentile • maximum	
Nitrogen monoxide (NO)	• annual mean • 50 percentile • 95 percentile • 98 percentile • maximum	• annual mean • 50 percentile • 95 percentile • 98 percentile • maximum	
Nitrogen oxides (NO_x) [b]	• annual mean • 50 percentile • 95 percentile • 98 percentile • maximum	• annual mean • 50 percentile • 95 percentile • 98 percentile • maximum	
Ozone (O_3)	• annual mean • 50 percentile • 95 percentile • 98 percentile • maximum • AOT40	• annual mean • 50 percentile • 95 percentile • 98 percentile • maximum	• annual mean • 50 percentile • 95 percentile • 98 percentile • maximum • days with c >120 μg/m^3, • 26th highest value • SOMO35
Carbon monoxide (CO)	• annual mean • 50 percentile • 95 percentile • 98 percentile • maximum	• annual mean • 50 percentile • 95 percentile • 98 percentile • maximum	• annual mean • 50 percentile • 95 percentile • 98 percentile • maximum
Particulate matter (PM_{10})	• annual mean • 50 percentile • 95 percentile • 98 percentile • maximum	• annual mean • 50 percentile • 95 percentile • 98 percentile • maximum • days with c > 50 μg/m^3, • 8th highest value • 36th highest value	
other	• annual mean • 50 percentile • 95 percentile • 98 percentile • maximum	• annual mean • 50 percentile • 95 percentile • 98 percentile • maximum	

Table B1. Calculated statistics in AIRBASE

For each statistic the data coverage[17] percentage is calculated. This is done as follows:

$$Data\ coverage = N_{valid} / N_{year} * 100\ \%$$

where N_{valid} is the number of valid hourly/daily values and N_{year} is the number of hours/days in the year

Calculation of aggregations and statistics

1. **All components**

- **Annual mean**
  The annual mean is calculated as follows:

  $$Annual\ mean = \Sigma_i C_i / N_{valid}$$

  where C_i is the valid hourly/daily/day8hmax concentration and the summation is over all valid hourly/daily values measured in the year. N_{valid} is the total number of valid hourly/daily values in the year.

- **Percentiles**
  The y^{th} percentile should be selected from the measurement values (valid hourly/daily/day8hmax concentrations). All the values should be listed in increasing order:

  $$X_1 \le X_2 \le X_3 \le ... \le X_k \le ... \le X_{N-1} \le X_N$$

  The y^{th} percentile is the concentration X_k, where the value of k is calculated as follows:

  $$k = (q \cdot N)$$

  with q being equal to $y/100$ and N the number of valid values. The value of $(q \cdot N)$ should be rounded off to the nearest whole number (values < 0.499999... are rounded to 0, values = 0.5 are rounded to 1).

- **Maximum**
  The (annual) maximum is calculated as follows:

  $$Maximum = max\ (C_i)$$

  where C_i are the valid hourly/daily/day8hmax concentrations and i is running over all valid hourly/daily/day8hmax values measured in the year.

2. **Only SO_2, NO_2, PM_{10}, O_3**

- **k^{th} highest value**
  The k^{th} highest value should be selected from the valid measurement values. All the values should be listed in decreasing order:

  - $X_1 \ge X_2 \ge X_3 \ge ... \ge X_k \ge ... \ge X_{N-1} \ge X_N$

  The k^{th} highest value is the concentration X_k.

[17] In the Air Quality Daughter Directives 2008/50/EC and 2004/170/EC the terms *data capture* and *time coverage* have been defined. The time coverage is the percentage of measurement time in a given period. The data capture is the percentage of valid measurement values in a given data set. For each yearly time series the so called *data coverage* has been calculated in AirBase. The *data coverage* is defined as follows: *Data coverage = data capture * time coverage.*

Example: the limit value for the protection of human health for PM_{10} is that the daily average of 50 µg/m³ will not be exceeded on more than 35 days per year. If the 36th highest value is more than 50 µg/m³, the limit value for PM_{10} has been exceeded.

- **Number of hours/days with concentration > y µg/m³**
  The *n* number of hours/days with concentration > y µg/m³ (with y = limit or threshold value) can be calculated from the valid measurement values:

$$X_1 , X_2 , X_3 , \dots , X_k , \dots , X_{N-1} , X_N$$

  N is the number of X_k-values for whick $X_k >$ *y* µg/m³. If *n* > 35 in the example on PM_{10} at the previous bullet, the limit value for PM_{10} has been exceeded.

3. Only O_3, CO

- **8-hour running averages**
  The 8-hour running averaged value for each hour is calculated as the average of the values for that hour and the 7 foregoing hours (averaging period). So, the averaging period of $hour_1$ of day_n is $hour_{17}$ of day_{n-1} until $hour_1$ of day_n. The averaging period of $hour_{24}$ of day_n is $hour_{16}$ of day_n until $hour_{24}$ of day_n.

- **Maximum daily 8-hour mean**
  The maximum daily 8-hour mean for a day is the maximum of the 8-hours running averages for that day

4. Only O_3

- **AOT40 (crops)**
  (Accumulated dose of ozone Over a Threshold of 40 ppb)
  AOT40 means the sum of the differences between hourly concentrations greater than 80 µg/m³ (= 40 parts per billion) and 80 µg/m³:

$$AOT40_{measured} = \Sigma_i \, max(0,(C_i - 80))$$

  where C_i is the hourly mean ozone concentration in µg/m³ and the summation is over all hourly values measured between 8.00 – 20.00 Central European Time[18] each day and for days in the 3 month growing season crops from 1 May to 31 July.

  AOT40 has a dimension of (µg/m³)·hours. AOT40 is sensitive to missing values and a correction to full time coverage has been applied:

$$AOT40_{estimate} = (AOT40_{measured} \cdot N_{period}) / N_{valid}$$

  where N_{valid} is the number of valid hourly values and N_{period} is the number of hours in the period.

- **SOMO35**
  (Sum of Ozone Means Over 35 ppb)
  For quantification of the health impacts the World Health Organisation recommends the use of the SOMO35 indicator.SOMO35 means the sum of the differences between maximum daily 8-hour concentrations greater than 70 µg/m³ (= 35 parts per billion) and 70 µg/m³:

$$SOMO35_{measured} = \Sigma_i \, max(0,(C_i - 70))$$

[18] In AirBase the time zone was disregarded. So the values between 8.00 – 12.00 in the reported time have been taken.

where C_i is the maximum daily 8-hour ozone concentration in µg/m^3 and the summation is over all days per calendar year.

SOMO35 has a dimension of (µg/m^3)·days. SOMO35 is sensitive to missing values and a correction to full time coverage has been applied:

$$SOMO35_{estimate} = (SOMO35_{measured} \cdot N_{period}) / N_{valid}$$

where N_{valid} is the number of valid daily values and N_{period} is the number of days per year.

2. Other than hourly and daily values: n-day (n>1), n-week, n-month, year and var[19]

Non automatic measured components (e.g. the components from the 4th DD (Heavy Metals and PAHs) have also other averaging times than hour and day: week, 2-week, 4-week, month, 3-month, year etc.). These measurements consist of samples with a start date/time and an end date/time. The averaging time is the period of the sample (end date/time minus start date/time). If the sample periods of a component differ 25% or more from a constant averaging time, the averaging time has been defined as "var". Example: if all periods of 4week samples are within 21 and 35 days, the averaging time is still 4week. The 100% period for a nmonth sample has been defined as the period starting from the start date/time of the sample and ending on the same day number and time n months later. Example: the sample starts at 5 March at 00:00, the 100% 1-month period is until 5 April at 00:00. Other example: the sample starts at 30 January at 00:00, the 100% 1-month period is until "virtual" 30 February, that is actually 2 March at 00:00 (no leap year). So if the end date/time is between 27 March 18:00 and 22 April 18:00 the sample period has still 1month averaging time.

The only statistics calculated for these averaging times are:

- annual mean
- 50 percentile
- 95 percentile
- 98 percentile
- maximum

All statistics calculations are done in analogy to the hourly/daily statistics calculations except for the annual mean and the data coverage. These quantities are calculated on base of the number of hours in the sample periods.
So the data coverage is calculated as follows:

$$Data\ coverage = \Sigma_i N_{valid,i} / N_{year} * 100\ \%$$

where $N_{valid,i}$ is the number of hours in the valid sample i and N_{year} is the number of hours in the year

The annual means are calculated according to the formula:

$$Annual\ mean = \Sigma_i N_i C_i / \Sigma_i N_i \qquad i=1, \quad n$$

where

[19] n-hour values are aggregated into daily values. The statistics are based on these daily values.

N_i = the number of hours of the sampling period i within the calendar year
N'_i = the number of hours in the total sampling period i
C_i = corrected concentration for sampling period i
$= C'_i * (N_i / N'_i)$
C'_i = Valid concentration reported for sampling period i

3. Calculation of NO_x values

To obtain a better coverage of NO_x-measurements in AirBase, AirBase has NO_x-values available which are derived from reported NO- and NO_2-results following the formula :

$$C_{NOx} = C_{NO2} + ((M_{NO2} / M_{NO}) * C_{NO})$$

where

$C_{NOx} = NO_x$ *concentration in* $\mu g\ NO_2/m^3$
$C_{NO2} = NO_2$ *concentration in* $\mu g/m^3$
C_{NO} = *NO concentration in* $\mu g/m^3$
M_{NO} = *MolecularMass of NO* = 30
M_{NO2} = *MolecularMass of* NO_2 = 46

For defining the measurement configuration of the derived NO_x measurements, the information is used of the measurement configuration of NO.
In case NO, NO_2 and NO_x are all reported, the reported NO_x-values will have priority over the derived NO_x-values.

Annex C. EoI2012 QA/QC timetable

Overview of the QA/QC activities undertaken by the data suppliers and ETC/ACM during the EoI2012 reporting cycle is given in *Table B1.* The QA/QC checks are described in "Quality checks on air quality data in AirBase and the EoI data in 2012" (see Mol 2012).

Table C1. QA/QC actions on EoI2012 data

Date	Processes by data supplier	Processes by ETC/ACM
12 May 2012		Release of the DEMv14
	Modifying meta data in the DEM Checking meta data in the DEM Import raw data into the DEM Checking raw data in the DEM Submit EoI to Central Data Repository (CDR)	Help desk
1 Oct 2012 to 15 Dec 2012		Upload DEM into AirBase Checks on outliers, missing essential meta data, missing data, resubmission old data, deletion stations/measurement configurations with data. Send feedback reports to the data suppliers
	Replies on the feedback reports, submitting missing data	
		Processing of the replies
15 December 2012 to 22 December 2012		Delivery of interim version of AirBase to EEA Checks by EEA Release of interim version of AirBase on EEA Data Service
15 Dec 2012 to 1 Feb 2013	Replies on the feedback reports, submitting missing data	
		Upload data received in this period (MT, DE, IT)
		Processing of the (non) replies
1 Feb to 8 Febr 2013		Calculation of statistics and exceedances
13 February 2013		Delivery first version AirBase to EEA
13 Febr to 14 Febr 2013		Checks by EEA
19 February 2013		Delivery final AirBase to EEA
1 March 2013		Release of AirBase on EEA Data Service (see airbase history page)

Most feedback is on the outliers. With the outlier checks also errors in units can be detected.

38 countries have delivered EoI2011 data (see status table http://acm.eionet.europa.eu/databases/country_tools/aq/eoi_to_airbase_status/index_html)
Nearly all countries have given response on the feedback.

The feedback has been placed on CDR:
http://cdr.eionet.europa.eu/ReportekEngine/resultsfeedbacks?dataflow_uris=http%3A%2F%2

Frod.eionet.europa.eu%2Fobligations%2F131&startdate%3Adate%3Aignore_empty=&enddate%3Adate%3Aignore_empty=&country=&sort_on=reportingdate&sort_order=reverse Most countries have placed their responses also on CDR. The responses of some countries have been placed on Forum: http://forum.eionet.europa.eu/eionet-air-climate/library/qaqc_country_feedback/eoi-2012-2011-data

One can also use the status table to find very easily all feedback information.

Information on Circa is not public. For access to this information an Eionet user account and password is needed.

Table C2. Status overview of QA/QC feedback actions on the EoI-2012 reporting cycle

Country feedback EoI2012									
Country		**outliers detected**	**outliers statistics detected**	**missing data**	**missing essential data**	**resubm.**	**deleted meta with data stored**	**deleted meta without data stored**	**EMEP data reported**
AL	Albania								
AT	Austria								
BA	Bosnia-Herzegovina								
BE	Belgium								
BG	Bulgaria								
CH	Switzerland								
CY	Cyprus								
CZ	Czech Republic								
DE	Germany								
DK	Denmark								
EE	Estonia								
ES	Spain								
FI	Finland								
FR	France								
GB	United Kingdom								
GR	Greece								
HR	Croatia								
HU	Hungary								
IE	Ireland								
IS	Iceland								
IT	Italy								
LI	Liechtenstein								
LT	Lithuania								
LU	Luxembourg								
LV	Latvia								
ME	Montenegro								
MK	FYR of Macedonia								
MT	Malta								
NL	Netherlands								
NO	Norway								
PL	Poland								
PT	Portugal								
RO	Romania								
RS	Serbia								
SE	Sweden								
SI	Slovenia								
SK	Slovak Republic								
TR	Turkey								

Legend:

	detected in country-report
	not detected in country-report
	not yet processed

Annex D. Component groups VOC, Pb_aer, Heavy Metals 4DD (HM4) and PAHs 4DD (PAH4)

Component group Volatile Organic Compounds (VOC) (VOC- = VOC – Benzene)

CompNmbr	CompShortName	CompName	Matrix
20	C6H6	Benzene	air
21	C6H5-CH3	Toluene	air
24	CH2=CH-CH=CH2	1.3 Butadiene	air
25	HCHO	Formaldehyde	air
32	THC (NM)	Total non-methane hydrocarbons	air
316	(CH3)2-CH-CH2-CH2-CH3	i-Hexane (2-methylpentane)	air
394	H3C-CH2-CH2-CH3	n-Butane	air
428	C2H6	Ethane	air
430	H2C=CH2	Ethene (Ethylene)	air
431	C6H5-C2H5	Ethyl benzene	air
432	HC=CH	Ethyne (Acetylene)	air
441	C7H16	n-Heptane	air
443	C6H14	n-Hexane	air
447	H3C-CH(CH3)2	i-Butane (2-methylpropane)	air
449	(CH3)3-C-CH2-CH-(CH3)2	i-Octane (2,2,4-trimethylpentane)	air
450	H3C-CH2-CH(CH3)2	i-Pentane (2-methylbutane)	air
451	CH2=CH-C(CH3)=CH2	Isoprene (2-methyl-1,3-butadiene)	air
464	m,p-C6H4(CH3)2	m,p-Xylene	air
475	C8H18	n-Octane	air
482	o-C6H4-(CH3)2	o-Xylene	air
486	H3C-(CH2)3-CH3	n-Pentane	air
503	H3C-CH2-CH3	Propane	air
505	CH2=CH-CH3	Propene	air
6005	H2C=CH-CH2-CH3	1-Butene	air
6006	trans-H3C-CH=CH-CH3	trans-2-Butene	air
6007	cis-H3C-CH=CH-CH3	cis-2-Butene	air
6008	H2C=CH-CH2-CH2-CH3	1-Pentene	air
6009	H3C-HC=CH-CH2-CH3	2-Pentenes	air
6011	1,2,4-C6H3(CH3)3	1,2,4-Trimethylbenzene	air
6012	1,2,3-C6H3(CH3)3	1,2,3-Trimethylbenzene	air
6013	1,3,5-C6H3(CH3)3	1,3,5-Trimethylbenzene	air

Component group Lead in aerosol (Pb_aer)

CompNmbr	CompShortName	CompName	Matrix
12	Pb	Lead	aerosol
1012	Pb in PM2.5	Lead in PM2.5	aerosol
3012	Pb in TSP	Lead in TSP	aerosol
5012	Pb in PM10	Lead in PM10	aerosol

Component group Heavy Metals in 4DD (HM4)

CompNmbr	CompShortName	CompName	Matrix
13	Hg	Mercury	aerosol
14	Cd	Cadmium	aerosol
15	Ni	Nickel	aerosol
18	As	Arsenic	aerosol
653	Hg-reactive	reactive_mercury	air+aerosol
2013	Hg	Mercury	precip
2014	Cd	Cadmium	precip
2015	Ni	Nickel	precip
2018	As	Arsenic	precip
3013	Hg in TSP	Mercury in TSP	aerosol
3014	Cd in TSP	Cadmium in TSP	aerosol
4013	Hg	Mercury	air+aerosol
4813	Hg0 + Hg-reactive	Total gaseous mercury	air + aerosol
5013	Hg in PM10	Mercury in PM10	aerosol
5014	Cd in PM10	Cadmium in PM10	aerosol
5015	Ni in PM10	Nickel in PM10	aerosol
5018	As in PM10	Arsenic in PM10	aerosol
7013	Hg	Mercury	precip+dry_dep
7014	Cd	Cadmium	precip+dry_dep
7015	Ni	Nickel	precip+dry_dep
7018	As	Arsenic	precip+dry_dep

Component group Polycyclic Aromatic Hydrocarbons in 4DD (PAH4)

29	BaP	Benzo(a)pyrene	precip
6015	BaP	Benzo(a)pyrene	air+aerosol
7029	BaP	Benzo(a)pyrene	precip+dry_dep
5029	BaP in PM10	Benzo(a)pyrene in PM10	aerosol
5129	BaP in PM10	Benzo(a)pyrene in PM10	air + aerosol
1029	BaP in PM2.5	Benzo(a)pyrene in PM2.5	aerosol
609	Benzo(a)anthracene	Benzo(a)anthracene	air+aerosol
610	Benzo(a)anthracene	Benzo(a)anthracene	precip
611	Benzo(a)anthracene	Benzo(a)anthracene	precip+dry_dep
5609	Benzo(a)anthracene in PM10	Benzo(a)anthracene in PM10	air+aerosol
5610	Benzo(a)anthracene in PM10	Benzo(a)anthracene in PM10	aerosol
616	Benzo(b)fluoranthene	Benzo(b)fluoranthene	air+aerosol
617	Benzo(b)fluoranthene	Benzo(b)fluoranthene	precip
618	Benzo(b)fluoranthene	Benzo(b)fluoranthene	precip+dry_dep
5616	Benzo(b)fluoranthene in PM10	Benzo(b)fluoranthene in PM10	air+aerosol
5617	Benzo(b)fluoranthene in PM10	Benzo(b)fluoranthene in PM10	aerosol
759	Benzo(j)fluoranthene	Benzo(j)fluoranthene	precip
760	Benzo(j)fluoranthene	Benzo(j)fluoranthene	precip+dry_dep
762	Benzo(j)fluoranthene	Benzo(j)fluoranthene	air+aerosol
5759	Benzo(j)fluoranthene in PM10	Benzo(j)fluoranthene in PM10	aerosol
5762	Benzo(j)fluoranthene in PM10	Benzo(j)fluoranthene in PM10	air+aerosol
625	Benzo(k)fluoranthene	Benzo(k)fluoranthene	air+aerosol
626	Benzo(k)fluoranthene	Benzo(k)fluoranthene	precip
627	Benzo(k)fluoranthene	Benzo(k)fluoranthene	precip+dry_dep
5625	Benzo(k)fluoranthene in PM10	Benzo(k)fluoranthene in PM10	air+aerosol
5626	Benzo(k)fluoranthene in PM10	Benzo(k)fluoranthene in PM10	aerosol
419	Dibenzo(ah)anthracene	Dibenzo(ah)anthracene	precip
763	Dibenzo(ah)anthracene	Dibenzo(ah)anthracene	air+aerosol
7419	Dibenzo(ah)anthracene	Dibenzo(ah)anthracene	precip+dry_dep
5419	Dibenzo(ah)anthracene in PM10	Dibenzo(ah)anthracene in PM10	aerosol
5763	Dibenzo(ah)anthracene in PM10	Dibenzo(ah)anthracene in PM10	air+aerosol
654	Indeno-(1,2,3-cd)pyrene	indeno_123cd_pyrene	air+aerosol
655	Indeno-(1,2,3-cd)pyrene	indeno_123cd_pyrene	precip
656	Indeno-(1,2,3-cd)pyrene	indeno_123cd_pyrene	precip+dry_dep
5654	Indeno-(1,2,3-cd)pyrene in PM	indeno_123cd_pyrene in PM10	air+aerosol
5655	Indeno-(1,2,3-cd)pyrene in PM	indeno_123cd_pyrene in PM10	aerosol
5655	Indeno-(1,2,3-cd)pyrene in PM	indeno_123cd_pyrene in PM10	aerosol

Component group PM2.5 speciation in AQDD (PM2.5_spec)

CompNmbr	CompShortName	CompName	Matrix
1771	EC in $PM_{2.5}$	Elemental carbon in PM2.5	aerosol
1772	OC in $PM_{2.5}$	Organic carbon in PM2.5	aerosol
1045	NH_4^+ in $PM_{2.5}$	Ammonium in PM2.5	aerosol
1046	NO_3^- in $PM_{2.5}$	Nitrate in PM2.5	aerosol
1047	SO_4^{2-} in $PM_{2.5}$	sulphate in PM2.5	aerosol
1629	Ca^{2+} in $PM_{2.5}$	calcium in PM2.5	aerosol
1631	Cl^- in $PM_{2.5}$	chloride in PM2.5	aerosol
1657	K^+ in $PM_{2.5}$	potassium in PM2.5	aerosol
1659	Mg^{2+} in $PM_{2.5}$	magnesium in PM2.5	aerosol
1668	Na^+ in $PM_{2.5}$	sodium in PM2.5	aerosol