European exchange of monitoring information and state of the air quality in 2006

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Front pages photos (from top to bottom):
Highest station in AIRBASE: Station Sonnblick, Salzburg, Austria on 3106 meter above sea-level (photo © Umweltbundesamt, Wien, Austria, see http://www.umweltbundesamt.at/umweltschutz/luft/messnetz/sonnblick/) and
most northerly station in AIRBASE: station Zeppelin, Svalbard, Norway on +078°54'00"latitude (photo ©NILU, Kjeller, Norway see http://www.luftkvalitet.info/default.aspx?pageid=1072&st_id=427)

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Maps in Figure 2-9 in this report have been produced by Petr Ptasek of the Czech Hydrometeorological Institute (Český hydrometeorologický ústav).

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SUMMARY

Current air quality legislation of the European Union, Council Decision (97/101/EC), requires the Commission to prepare yearly a technical report on the meta information and air quality data that have been exchanged among the European Union Member States and the Commission. Besides the EU Member States, other member and cooperating countries of the European Environment Agency, which include EU candidate countries, EU potential candidate countries and EFTA states, have agreed to follow this reporting procedure as well. The information is made available in the AIRBASE database, accessible at "airbase.eionet.europa.eu". The results of the reporting cycle presented in this technical report cover data for 2006.

A total of 35 countries, including 27 EU Member States, have provided air quality data for 2006. 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 (VOCs), Heavy Metals (HMs) and Polycyclic Aromatic Hydrocarbons (PAHs) have been transmitted. Nearly all the countries that have updated their meta information have used the Air Quality Data Exchange Module (AQ-DEM), made available for this purpose by the European Topic Centre on Air and Climate Change (ETC/ACC).

This technical report not only describes the meta information and the quality of the measurement data but also the state of the air quality for some selected pollutants in 2006.

Pollution by SO_2 shows a decreasing trend both in emissions as well as in ambient concentrations. Exceedances of the health related SO_2 limit values are observed at a limited number of stations only. The emission of NO_x decreases but NO_2 concentrations in urban and traffic areas are decreasing at a much lower rate. Compliance with the NO_2 limit value for annual mean values is a serious problem in many urban and traffic areas. During the last five years emissions of primary PM_{10} and its precursor gasses are reducing slowly but in the observed concentrations no clear European-wide trend is seen. The PM_{10}-limit value for daily values is exceeded frequently at urban and traffic stations and occasionally at rural background stations. The ambient levels of CO are below the limit value; some incidental exceedances are observed. The benzene concentrations are in compliance with the limit values except for a limited number of urban and traffic hotspot situations. Ozone precursor emissions are decreasing; the ozone concentrations, however, do not show a decreasing trend. On the contrary, the health related and the annual mean values show an increasing tendency. Both the health and the ecosystem related target values are exceeded frequently and widely over Europe. The lead concentrations are well below the limit value for protection of human health. Several Member States have reported heavy metals (arsenic, cadmium, nickel) and benzo(a)pyrene regulated under the fourth Daughter Directive. The air pollution by these heavy metals is generally low: the concentrations are below the lower assessment threshold, for arsenic at the majority of the stations, and for cadmium and nickel at more than 90% of the stations. The benzo(a)pyrene annual mean concentrations however exceed the target value at about 40% of the 86 reported stations.

CONTENTS

INTRODUCTION

The reciprocal exchange among countries and the Commission is based on a series of Council Decisions. The latest 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', the Exchange of Information (EoI), was adopted by the European Council in 1997 (EU 1997). The annexes to the Decision have been amended to adapt the list of pollutants covered to changes and requirements on additional information, validation and aggregation (EU 2001a, EU 2001b). Data submission follows the Guidance on the revised Annexes of the Decision (Garber *et al.* 2001). An overview of the meta information to be delivered can be found in Annex A.

Parallel to dataflow under the EoI, the EU Member States provide information on air quality in the context of the Air Quality Framework (FWD; EU 1996) and related daughter directives (EU 1999, EU 2000, EU 2002, EU 2004a, EU2004b). This information mainly focuses on compliance checking with obligations under the air quality directives, such as limit values. To avoid duplicate reporting by the Member States, 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.

The EoI requires a large set of meta information and air quality 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'[1].

According to the EoI Decision, the Commission will, each year, prepare a technical report on meta information and air quality data exchanged, and make the information available to EU Member States. 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 and Climate Change (ETC/ACC), under contract to EEA, manages the database system, AIRBASE (see Mol *et al.* 2005a). 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). The contents of AIRBASE is available to the public via the EEA website[2]. More information on AIRBASE can be found on the ETC/ACC website[3]

Efforts have been made to load meta-information for all stations sending information on near real time (NRT) ozone to EEA[4] into AIRBASE. AIRBASE has become more and more the central database for the air quality meta information for the different air quality data flows: EoI, FWD (questionnaire, summer ozone reporting) and the NRT ozone Web site

This report shows information provided by EU-27 Member States, including Bulgaria and Romania. Note that these two countries joined the European Union at 01-01-2007 and that this report is handling 2006-data provided in 2007. In addition it contains information from other four EEA member countries and from four cooperating countries[5], which have agreed to follow the data exchange procedures in the framework of Euroairnet.

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[1] See Annex A for an overview.
[2] http://www.eea.europa.eu/themes/air/airbase
[3] http://airbase.eionet.europa.eu/
[4] http://www.eea.europa.eu/maps/ozone/welcome
[5] EU27 Member States: Austria, Belgium, Bulgaria (since 01-01-2007), 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 (since 01-01-2007), Slovenia, Slovakia. EU 25 Member States: EU27 Member States minus Bulgaria and Romania. Next 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 Yogoslav Repiblic of Macedonia (FYROM), Montenegro and Serbia.

This report also reports on the QA/QC aspects of the data in AIRBASE. The procedures and the first QA/QC checks are described in a report (see Mol *et al.* 2005b). A check for missing data has been added to the yearly QA/QC checks on the delivered EoI-data (outliers, missing essential meta data, possible overwriting of data already stored in AIRBASE, possible deletion of stations and measurement configurations with data). In addition to these standard checks also QA/QC checks are performed on questionable station coordinates.

In addition to the more technical aspects of the data submission process, this report will briefly describe the state of the air quality for some selected pollutants. The current (2006) air quality status will be described together with the changes in concentrations during the last 10 and 5 years.

1. EXCHANGE OF INFORMATION 2007 (DATA FOR 2006)

1.1. Data delivery

Thirty five countries, including all EU-27 Member States, provided air quality data for the reporting year 2006, Two additional countries (Luxembourg and Croatia) have delivered data in comparisom with the previous reporting cycle,
(see the status table in http://air-climate.eionet.europa.eu/country_tools/aq/eoi_to_airbase_status/index_html)

The delivery of data was facilitated by the Air Quality Data Exchange Module (AQ-DEM)[1], developed by the ETC/ACC. This tool was used by most of the countries. Some countries provided their data in files in the EoI specified formats (DEM and ISO-7168-1: 1999 (extended) format). All data delivered for the reporting year 2006 was loaded into AIRBASE. All statistics and exceedances relevant in the Daughter Directives have been calculated and were also loaded into AIRBASE.

1.2. QA/QC feedback actions

Several quality checks have been performed on delivered data and the already available information in AIRBASE. The quality checks in all steps of the EoI delivery process (the DEM checks and the QA/QC checks on the delivered data) are described in some reports (see Mol *et al.* 2005b, Mol 2007). The yearly QA/QC checks on the delivered EoI-data are checks on outliers, missing essential meta data, missing data, possible overwriting of data already stored in AIRBASE and possible deletion of stations and measurement configurations with data. In addition to these standard checks also QA/QC checks are performed on questionable station coordinates and questionable measurement data.

Intensive feedback took place with the data suppliers on these items. The country feedbacks sent to the member states resulted for 29 EoI reports in one or more updates of their original report 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. Results

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 less commonly monitored components. Although this report includes the available information up to March 2008, data processing is an ongoing process, so please refer to the AIRBASE website [2] for the most recent overview of the progress in processing the data.

The number of reporting countries varied per component ranging from all 35 for nitrogen dioxide, particulate matter and ozone to eight for one or more PAHs ((benzo(a)pyrene, benzo(a)anthracen, benzo(b)fluoranthen, benzo(j)fluoranthen, benzo(k)fluoranthen, indeno (1,2,3-cd)pyren en dibenzo(a,h)anthracene).

[1] http://air-climate.eionet.europa.eu/country_tools/aq/aq-dem/index_html
[2] http://air-climate.eionet.europa.eu/databases/airbase/history/index_html

The number of reporting stations in 2006 also varied accordingly, being 112 for one or more PAHs and 2870 for nitrogen dioxide. Differences in the distribution and density of reporting stations is illustrated for selected pollutants (*Figures 2 through 9)*. The expected EoI stations in these figures are described in Article 3 of the EoI decision (EU 1997). The EoI should cover at least the stations which are used in the FWD and the related Daughter Directives.

Overviews of reporting in 2006 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) and the number of stations providing data for one or more ozone precursors (VOCs; excluding benzene which is listed separately) and for the 4th Daughter Directive the number of stations with data for one or more Heavy Metals (As, Cd, Hg, Ni, excluding Pb which is listed separately) and one or more PAHs,
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 are as follows:

	Type of station	Type of area
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 2006 can be found in table A "number of stations per pollutant and station type and country in 2006" in http://air-climate.eionet.europa.eu/databases/airbase/eoi_tables/eoi2007/index_html

All stations with primary data (raw data with averages varying from hour to year) are taken into account in this chapter, regardless of the data coverage at that station. *Figure 1* compares the number of stations from *Table 1* with the number of stations with >=75% and >=90% data coverage[1]. For most components hourly and daily concentration data have been delivered. Also measurement data with other averaging times than hour and day have been delivered: weekly, 4-weekly, monthly, 3-monthly and yearly. These measurement data are related to the 4th DD pollutants (Heavy Metals and PAHs).

The daily values in AIRBASE have been calculated by ETC/ACC 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.

Stations which have delivered only statistics are not included in this report. However, the meta information of these stations and the statistics are available in AIRBASE. This evaluation focus on components defined under the Framework Directive (and the first three daughter directives). Most countries delivered data for more pollutants than the mandatory list of pollutants defined under the EoI. See table B "number of stations with HMs, VOCs, PAHs and other non-Directive components" in http://air-climate.eionet.europa.eu/databases/airbase/eoi_tables/eoi2007/index_html for a summary of these supplementary components.

[1] The data quality objectives as laid down in the Daughter Directives 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.

The number of stations for which data are reported has increased for the components NO_2 (+117),PM_{10} (+134), $PM_{2.5}$ (+51), O_3 (+70), VOCs excluding benzene (+63), HMs excluding Pb (+77) and PAHs (63) and decreased for the components SO_2 (-71), Pb (-10), CO(-42) and benzene (-13). The number of stations for which NO_x or NO +NO_2 has been reported has increased (+158) but there is still a difference of 775 stations 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. This is surprising as most automated monitors measure both pollutants simultaneously. See table C "number of stations with NO_2 , NO_x and NO" in http://air-climate.eionet.europa.eu/databases/airbase/eoi_tables/eoi2007/index_html for an overview per country.

Figure 1 Number of stations with 2006 data coverage >0% (with data), >=75% and >=90%. Data coverage is based on daily averages for SO_2, NO_2, NO_x ,PM_{10}, $PM_{2.5}$, Pb and Benzene, and based on daily running 8h maximum for CO and O_3

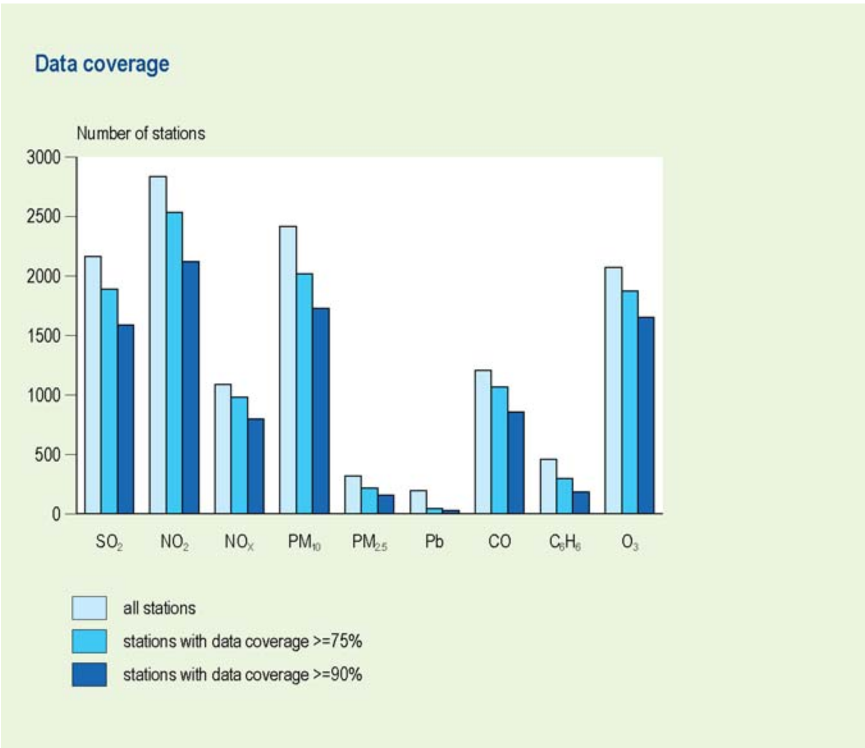


Table 1 Number of stations for which 2006 data have been delivered for Daughter Directives components, specified per station type.

	Daughter Directive											
	1	1	1	1	1	1	2	2	3	3	4	4
	SO2	NO2	NOx/NO	PM10	PM2.5	Pb	CO	C6H6	O3	VOC	HM	PAH
Reporting EU countries	27	27	25	27	19	15	27	21	27	11	13	8
Total number of stations	2074	2770	2031	2349	305	247	1164	551	2015	212	340	112
Of which												
Traffic	418	830	675	689	92	56	588	271	312	125	91	33
Urban background	831	1118	713	1004	124	105	401	179	952	43	112	58
Industrial	497	424	337	376	24	37	115	71	229	28	67	9
Rural background	298	352	295	248	56	48	45	25	473	6	69	12
Other (total)	30	46	11	32	9	1	15	5	49	10	1	
Reporting non-EU countries	7	8	7	8	3		7	5	8	2		
Total number of stations	91	100	64	74	15		45	18	59	6		
Of which												
Traffic	32	43	31	37	11		29	13	20	2		
Urban background	29	30	19	20	4		5	3	13	3		
Industrial	17	13	6	9			9	1	8			
Rural background	13	14	8	8			2	1	18	1		
Other (total)												
Total reporting countries	34	35	32	35	22	15	34	26	35	13	13	8
Total number of stations	2165	2870	2095	2423	320	247	1209	569	2074	218	340	112

Table 2 Number of stations for which 2006 data have been delivered for Daughter Directives components, specified per country.

	Daughter Directive											
	1	1	1	1	1	1	2	2	3	3	4	4
	SO2	NO2	NOx/NO	PM10	PM2.5	Pb	CO	C6H6	O3	VOC	HM	PAH
EU-27 countries												
AUSTRIA	115	147	147	111	6	14	40	23	114	2	16	11
BELGIUM	61	67	67	47	12	25	17	36	39		44	12
BULGARIA	15	14	14	37	4	19	13	12	13	5	17	17
CYPRUS	1	1	1	2			1		2			
CZECH REPUBLIC	89	92	92	119	29	25	32	26	60		25	20
DENMARK	5	12	12	11	4		7	2	9	2		
ESTONIA	7	7	7	4			5		7			
FINLAND	11	31	31	31	7		7		17			
FRANCE	361	524		380	60		100		466			
GERMANY	257	473	435	447	32		170	133	301	71	121	24
GREECE	12	23		12			9	1	21			
HUNGARY	24	24	23	24	3		20	11	17			
IRELAND	11	12	12	17		8	6	4	10	1		
ITALY	285	434	383	295	31	6	277	123	229	104	6	
LATVIA	6	7	1	3		4	1	4	6		4	2
LITHUANIA	12	15	12	12		7	8	4	13			
LUXEMBOURG	6	6	6	3	1		3		6			
MALTA	4	4	4	4	2	2	4	3	5	3	3	2
NETHERLANDS	35	51	44	39		4	22	8	38	8	4	
POLAND	144	144	88	157	4	26	57	21	56	2		
PORTUGAL	47	63	62	52	18		42	9	50			
ROMANIA	31	35	31	29	2	15	22	9	26	5	5	
SLOVAKIA	26	27	27	27	3	20	12	10	18		20	
SLOVENIA	22	10	10	10			5		11			
SPAIN	400	405	401	372	71	43	200	62	374		48	
SWEDEN	9	28	7	30	9		4	9	15			
UNITED KINGDOM	78	114	114	74	7	29	80	41	92	9	27	24
Total EU-27 countries	2074	2770	2031	2349	305	247	1164	551	2015	212	340	112
non-EU-27 countries												
BOSNIA - HERZEGOVINA	3	3	1	2	1		3		3			
CROATIA	8	8		8			8	4	3			
ICELAND	1	2	2	3	2		1	1	4	1		
LIECHTENSTEIN		1	1	1					1			
MACEDONIA, FYRO[1)]	36	14	14	12			14		13			
NORWAY	6	23	19	23	12		7	9	9			
SERBIA	24	23	3	1			1	1	1			
SWITZERLAND	13	26	24	24			11	3	25	5		
Total non-EU-27 countries	91	100	64	74	15	0	45	18	59	6	0	0
Total all countries	2165	2870	2095	2423	320	247	1209	569	2074	218	340	112

[1)] FYRO = the Former Yugoslav Republic Of

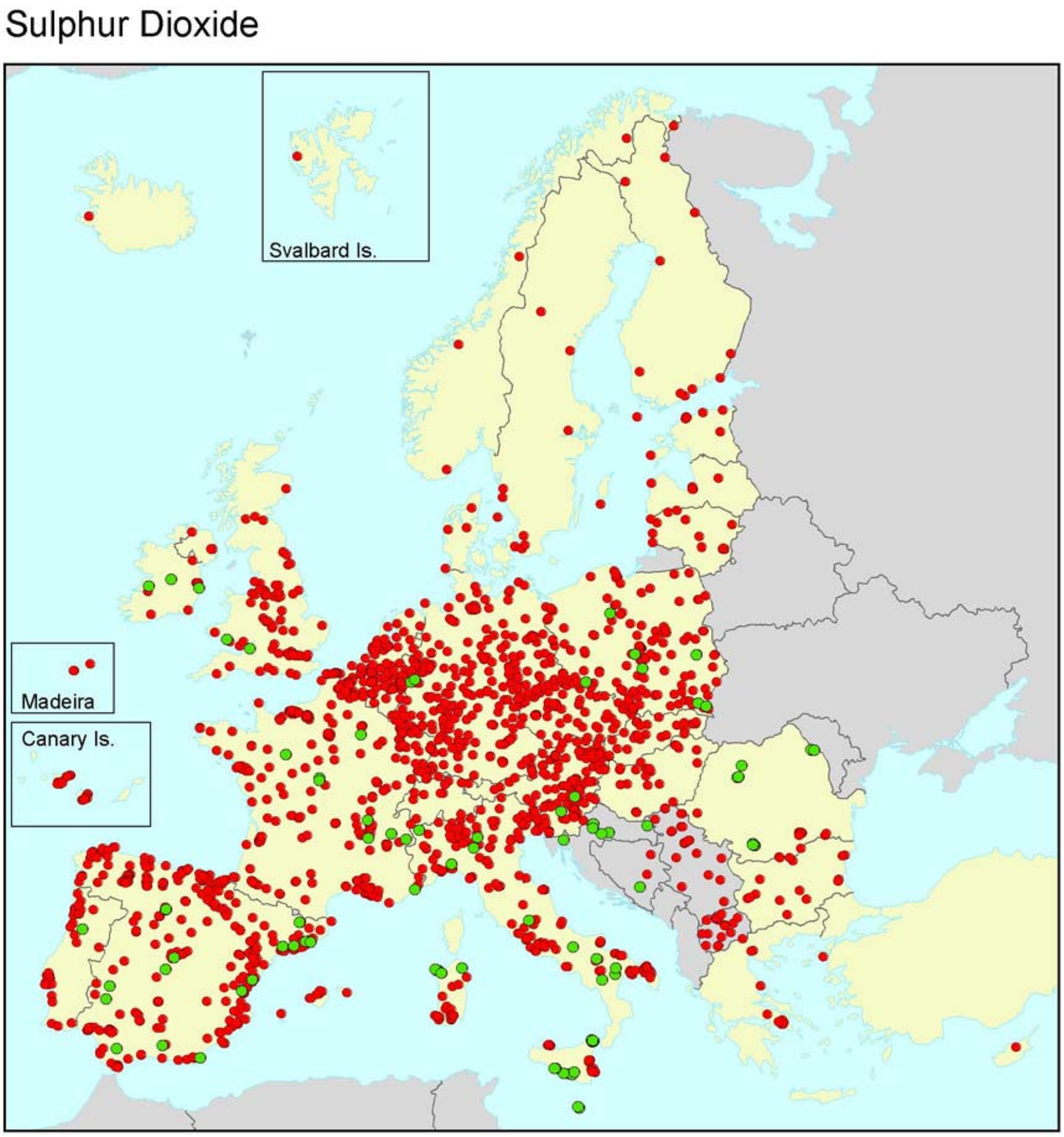


Figure 2 Location of stations for which 2006 air quality data for sulphur dioxide (SO_2) have been reported. The green stations report for the first time (new stations).

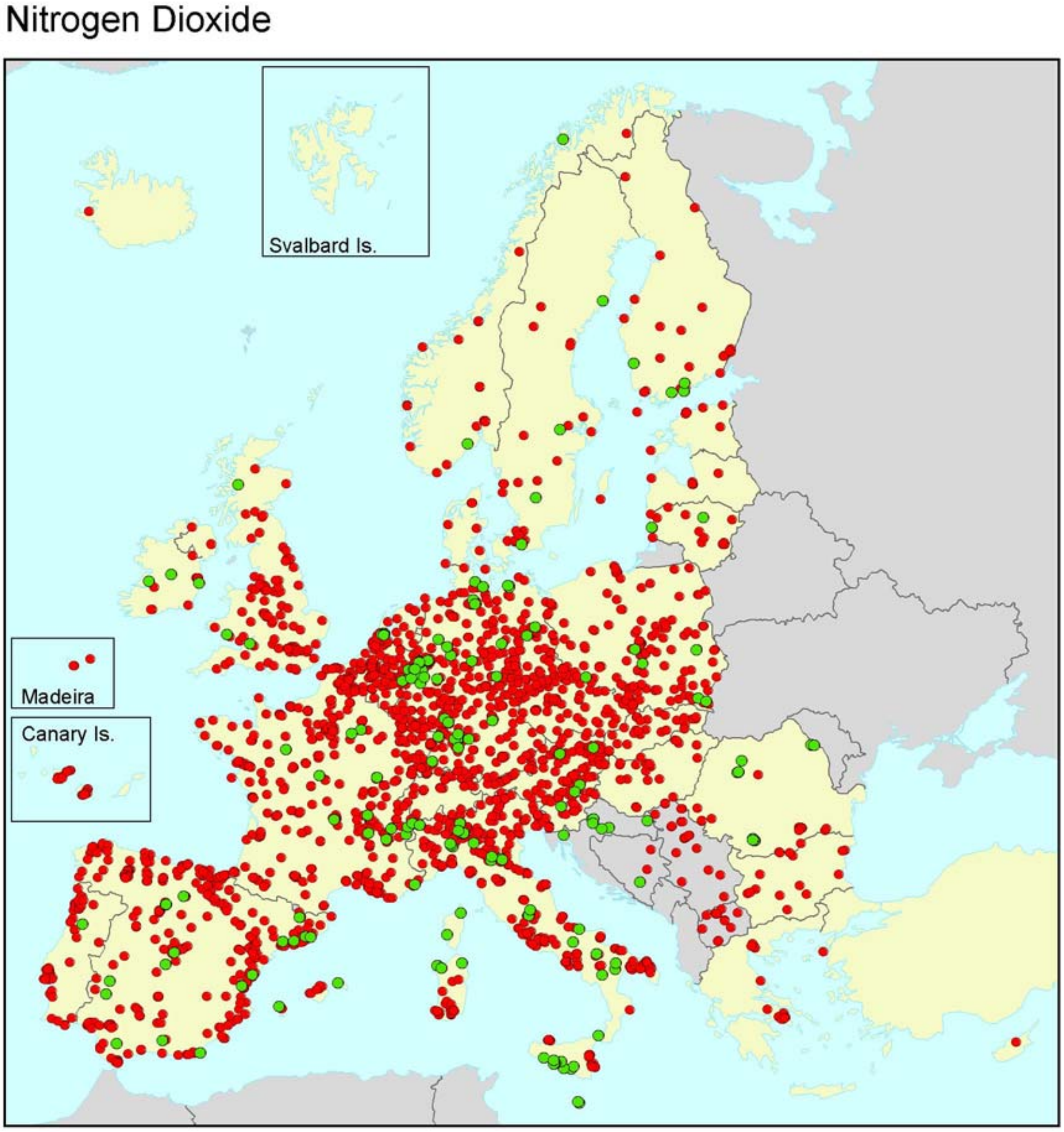


Figure 3 Location of stations for which 2006 air quality data for nitrogen dioxide (NO_2) have been reported. The green stations report for the first time (new stations).

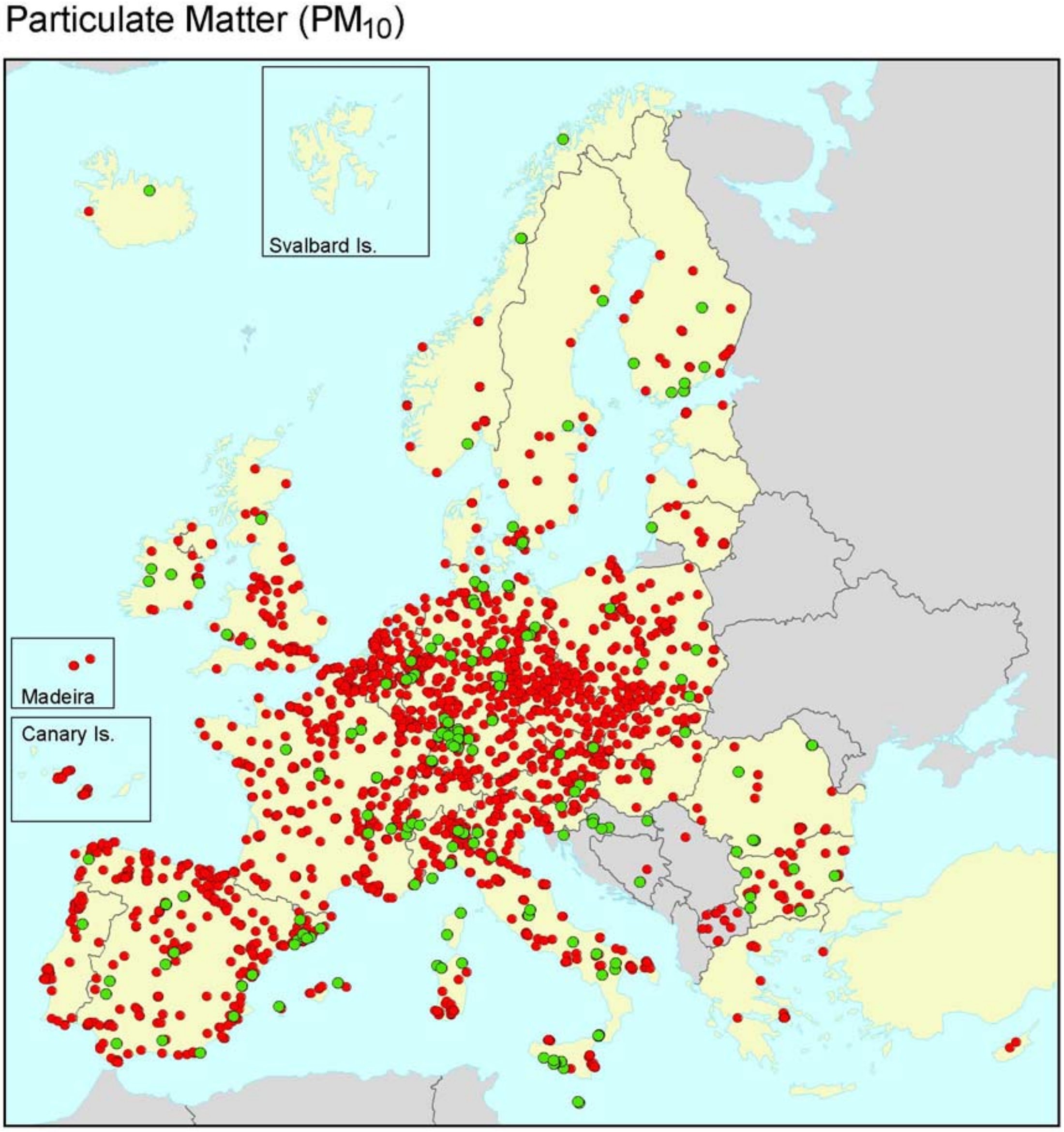


Figure 4 Location of stations for which 2006 air quality data for particulate matter (PM_{10}) have been reported. The green stations report for the first time (new stations).

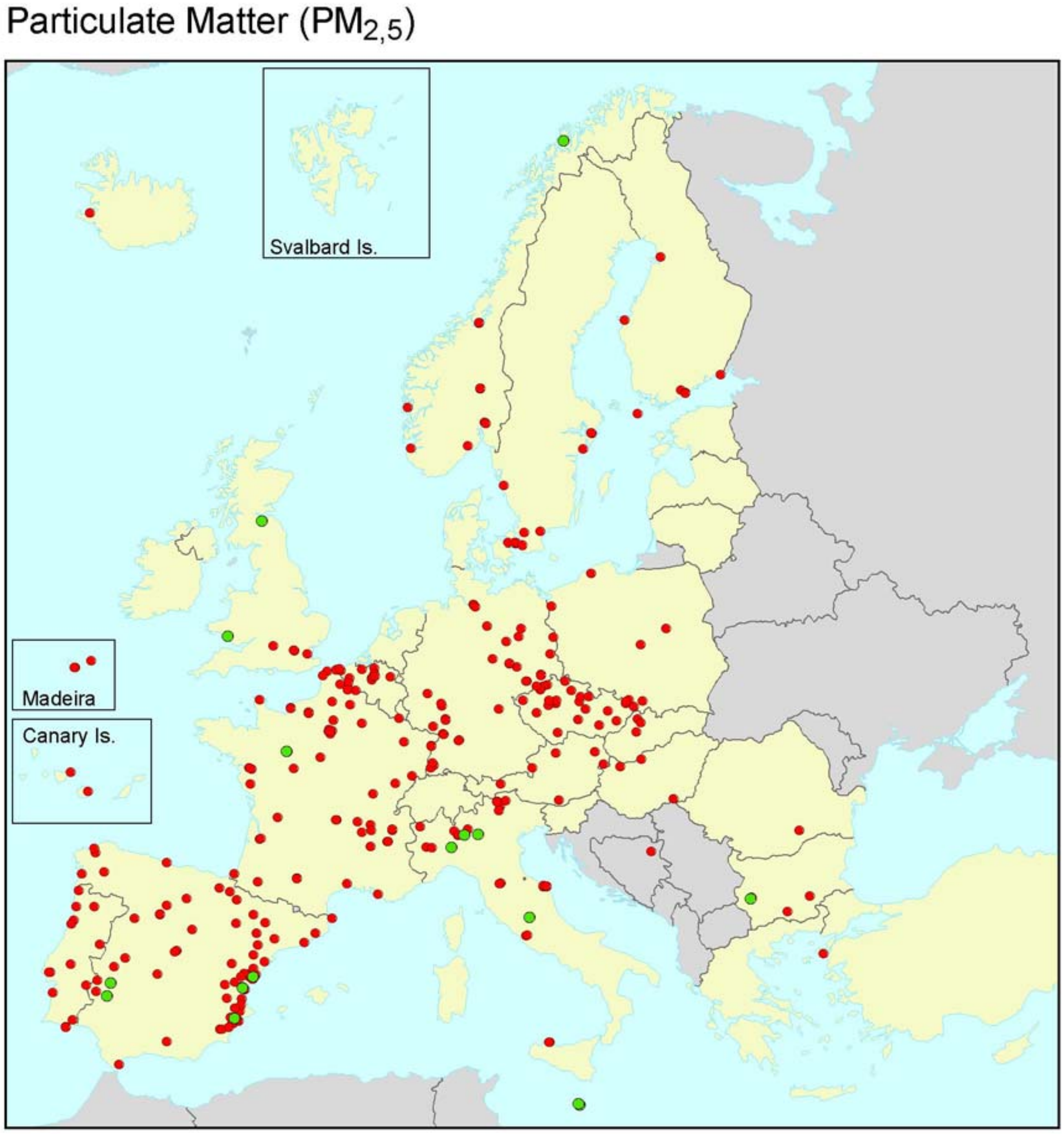


Figure 5 Location of stations for which 2006 air quality data for particulate matter ($PM_{2.5}$) have been reported. The green stations report for the first time (new stations).

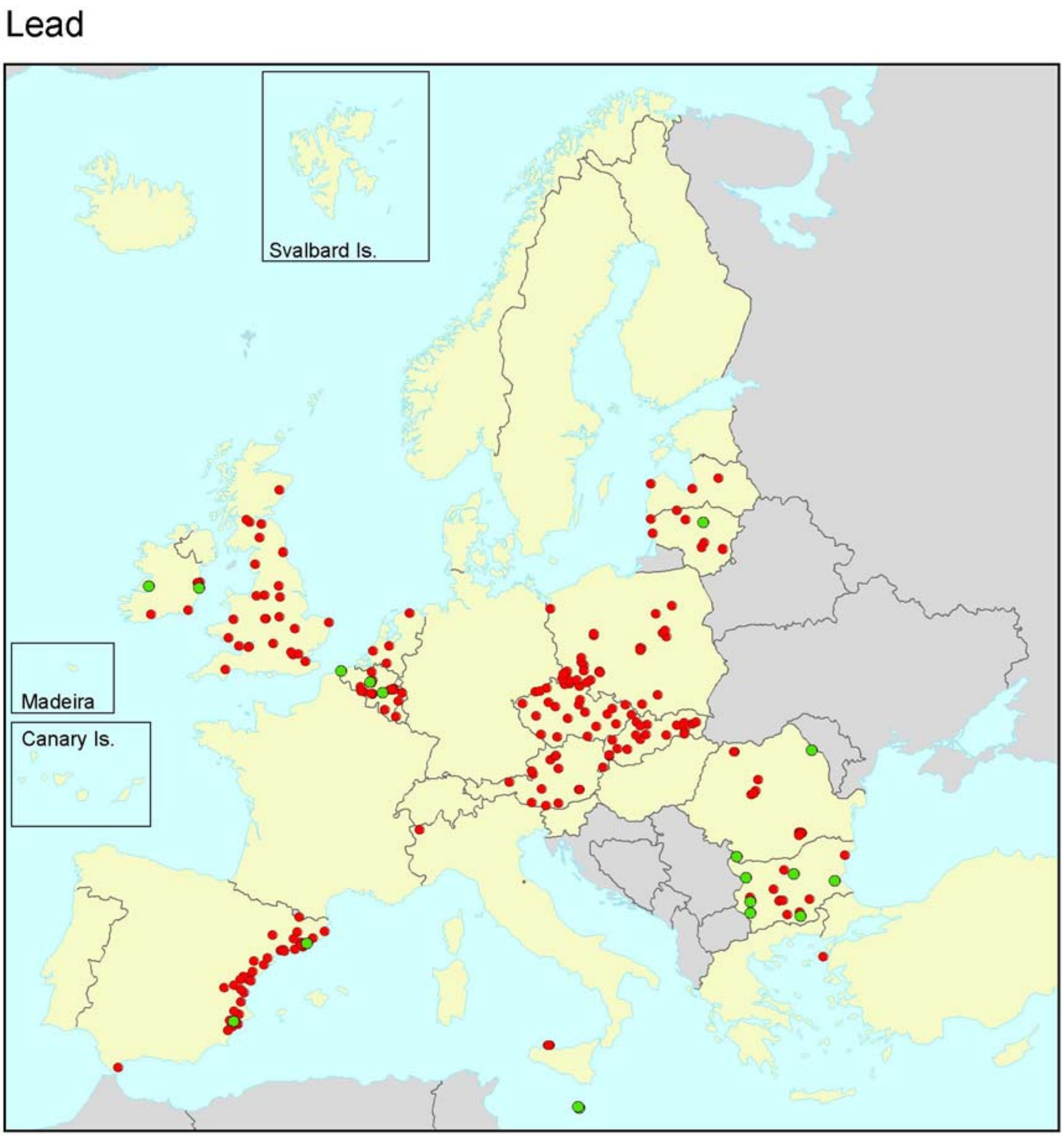


Figure 6 Location of stations for which 2006 air quality data for lead (Pb) have been reported. The green stations report for the first time (new stations).

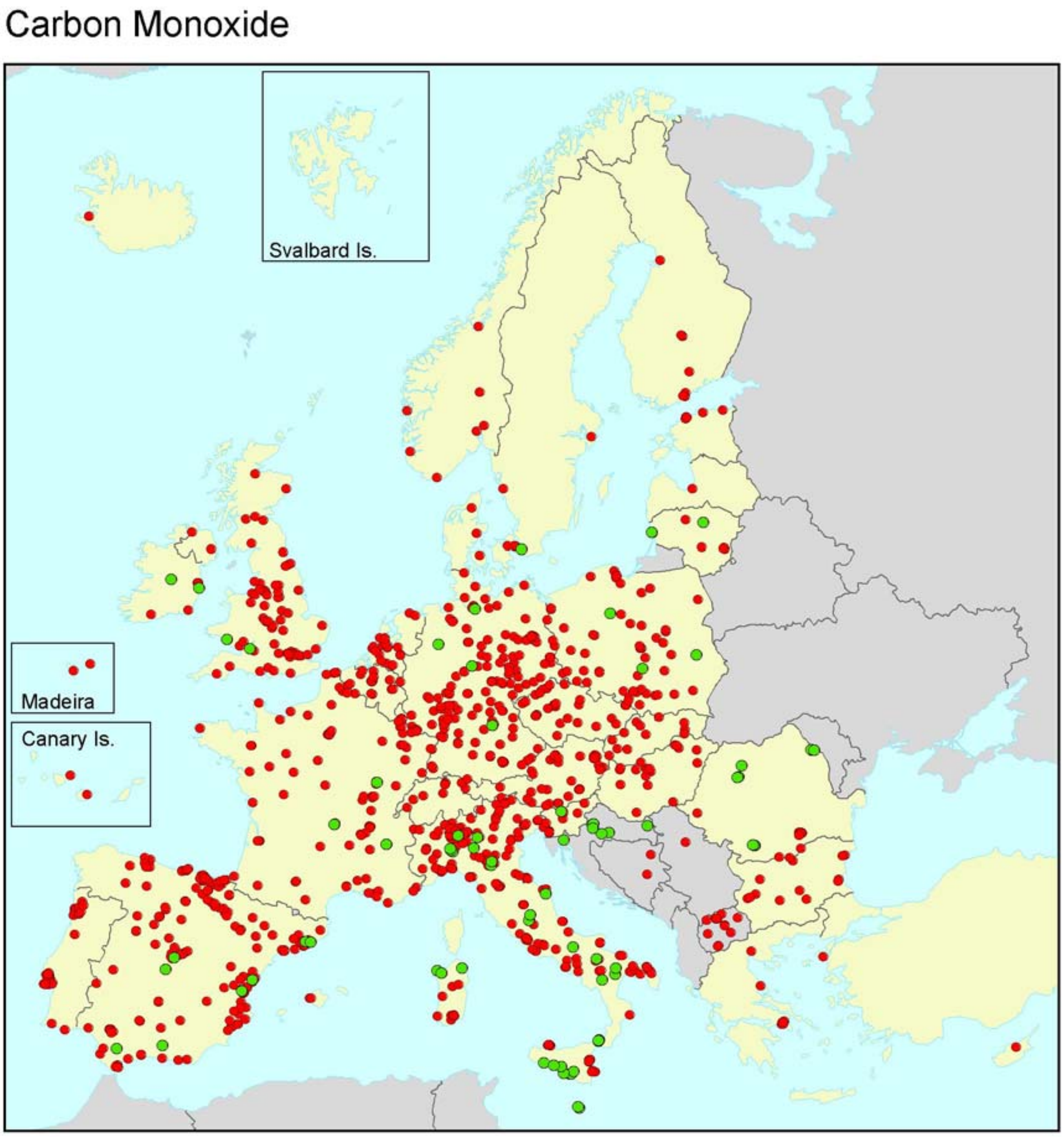


Figure 7 Location of stations for which 2006 air quality data for carbon monoxide (CO) have been reported. The green stations report for the first time (new stations).

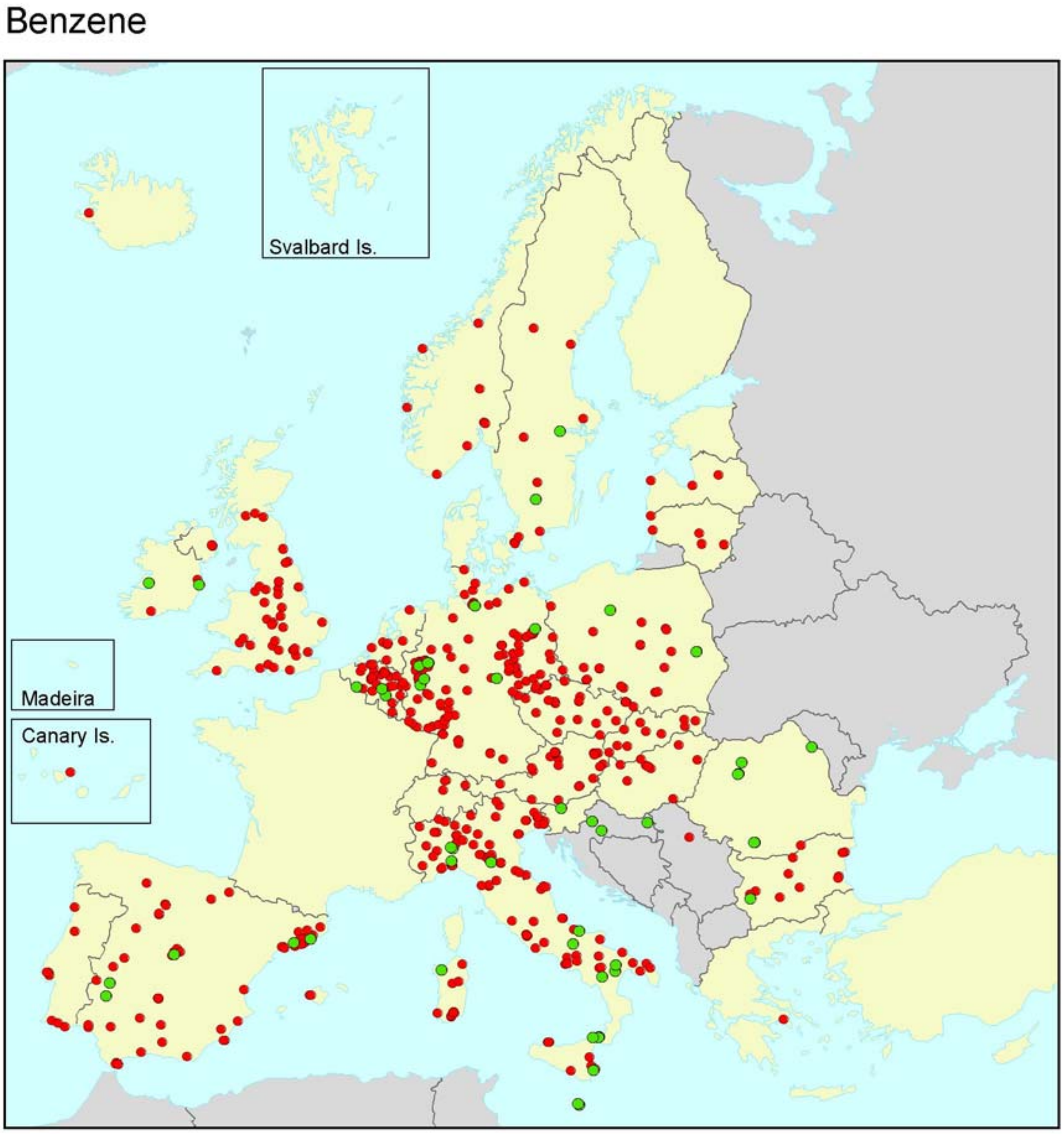


Figure 8 Location of stations for which 2006 air quality data for benzene (C_6H_6) have been reported. The green stations report for the first time (new stations).

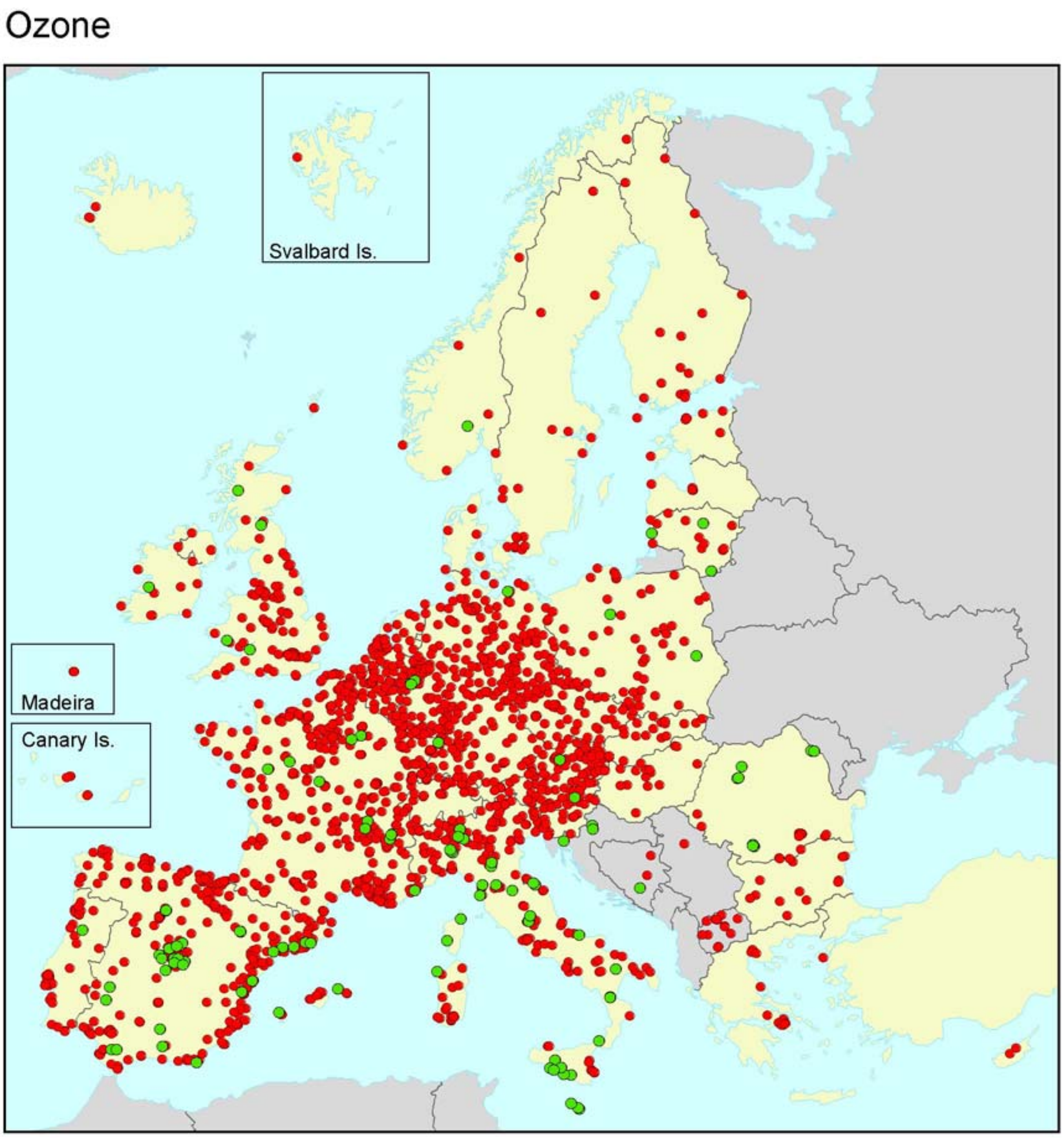


Figure 9 Location of stations for which 2006 air quality data for ozone (O_3) have been reported. The green stations report for the first time (new stations).

1.4. Total number of stations in AIRBASE

The total number of stations in AIRBASE is 6371, from which 5667 stations have measurement data. The 479 stations without data are partially stations for which meta information has been delivered under the EoI but no measurement data (Germany) and partially stations for which measurement data will be delivered (e.g. United Kingdom). But also stations reporting near real time (NRT) ozone[1] to the EEA and stations reporting Summer Ozone (3th FWD/DD)[2] data which have not yet delivered for the EoI are included. In spite of the EoI obligation to send only raw data or raw data combined with statistics, there are still 227 stations with only statistics in AIRBASE. Summarized, in AIRBASE we have:

5667	stations with raw data
227	stations with only statistics
5894	stations with data
477	stations without data
6371	stations in total

The exchange of information should cover at least the stations which are included in the FWD/Questionnaire (EU 2004b). However not all stations listed in the delivered questionnaires have been reported under the EoI (see Vixseboxse and de Leeuw. 2008). 700 questionnaire stations cannot be found in AIRBASE from which about 600 stations in Poland (see table 3). For most countries nearly all stations listed in the FWD-Questionnaire can be found in AIRBASE. However, this does not necessarily means that for each station/pollutant combination listed in the FWD-Questionnaire recent (2006) information is available in AIRBASE, see table F "match of stations and measurement configurations between questionnaire and AirBase" in http://air-climate.eionet.europa.eu/databases/airbase/eoi_tables/eoi2007/index_html for more details on the measurement configurations.

This year (2008) ETC/ACC intends to send a list of Questionnaire stations which are not in AIRBASE to the EoI data suppliers with the request to deliver both meta data and measurement data for these stations.

Information on stations with missing essential information, see table E "number of stations with/without data and with missing essential meta information" in http://air-climate.eionet.europa.eu/databases/airbase/eoi_tables/eoi2007/index_html.

[1] http://www.eea.europa.eu/maps/ozone/welcome
[2] http://air-climate.eionet.europa.eu/databases/o3excess/index_html

EU-27 countries	number of stations questionnaire	number of stations EoI
AUSTRIA	158	158
BELGIUM	161	161
BULGARIA	37	37
CYPRUS	2	2
CZECH REPUBLIC	155	155
DENMARK	12	12
ESTONIA	11	8
FINLAND	33	33
FRANCE	646	627
GERMANY	519	519
GREECE	27	27
HUNGARY	26	26
IRELAND	21	21
ITALY	411	328
LATVIA	9	9
LITHUANIA	16	16
LUXEMBOURG	6	5
MALTA	4	4
NETHERLANDS	51	51
POLAND	801	211
PORTUGAL	45	45
ROMANIA	23	23
SLOVAKIA	32	32
SLOVENIA	23	23
SPAIN	478	478
SWEDEN	43	43
UNITED KINGDOM	191	191
Total EU27	3941	3245
Non-EU-27 countries		
ICELAND	3	3
NORWAY	14	13
Total non-EU27	17	16
Grand total	3958	3261

Table 3 Number of stations in the questionnaire-2007 and the number of these stations found in AIRBASE.

1.5. Time series

The total number of stations with raw data which are operational in 2006 is 3987 (see *Table 4*).

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 be found in *Table 5*. Note that the length of the time series in years in *Table 5* and table D “Information on time series in AirBase” are calculated regardless of the data capture 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 10* for several components. However, as one of the long-term objectives is to expand the time series in AIRBASE by encouraging countries to deliver historical data, further improvement can be expected.

More information about time series can be found in table D “Information on time series in AirBase” in http://air-climate.eionet.europa.eu/databases/airbase/eoi_tables/eoi2007/index_html

Table 4 Summary of periods and number of stations for which data have been delivered in the whole period and only in 2006.

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 2006 data have been delivered [1)]
EU-27 countries			
AUSTRIA	1990-2006	232	183
BELGIUM	1985-2006	292	201
BULGARIA	1998-2006	60	37
CYPRUS	2003-2006	2	2
CZECH REPUBLIC	1992-2006	141	129
DENMARK	1976-2006	39	14
ESTONIA	1997-2006	9	7
FINLAND	1990-2006	82	55
FRANCE	1973-2006	981	728
GERMANY	1976-2006	891	561
GREECE	1983-2006	34	25
HUNGARY	1997-2006	37	26
IRELAND	1973-2006	80	25
ITALY	1976-2006	704	521
LATVIA	1997-2006	18	9
LITHUANIA	1997-2006	23	17
LUXEMBOURG	1976-2006	12	6
MALTA	2002-2006	6	5
NETHERLANDS	1976-2006	77	62
POLAND	1997-2006	256	219
PORTUGAL	1986-2006	94	67
ROMANIA	1999-2006	59	50
SLOVAKIA	1995-2006	47	36
SLOVENIA	1997-2006	25	25
SPAIN	1986-2006	683	546
SWEDEN	1993-2006	57	47
UNITED KINGDOM	1969-2006	552	242
Total		*5493*	*3845*
Non-EU-27 countries			
ALBANIA			
BOSNIA - HERZEGOVINA	2002-2006	4	4
CROATIA	2006-2006	8	8
ICELAND	1993-2006	9	5
LIECHTENSTEIN	2004-2006	2	1
MACEDONIA, FYRO [2)]	1997-2006	44	41
MONTENEGRO			
NORWAY	1994-2006	45	33
SERBIA	2002-2006	25	24
SWITZERLAND	1992-2006	37	26
TURKEY			
Total		*174*	*142*
Total EU-27 + non-EU-27 countries		*5667*	*3987*

1) Irrespective of the component(s) measured; excluding only statistics data

2) FYRO= Former Yugoslavian Republic Of

Table 5 All (primary) AIRBASE data (raw data, not the derived data as statistics) of all 35 countries have been taken into account in calculating the average length of time series regardless of the starting year.

Component	Average length of time series		Component	Average length of time series
	Year			*Year*
Sulphur dioxide	5.8		Lead	3.2
Nitrogen dioxide	5.6		Carbon monoxide	4.9
Nitrogen oxides	3.5		Benzene	3.0
Particulate matter < 10 µm	4.1		Ozone	6.2
Particulate matter < 2.5 µm	2.6			

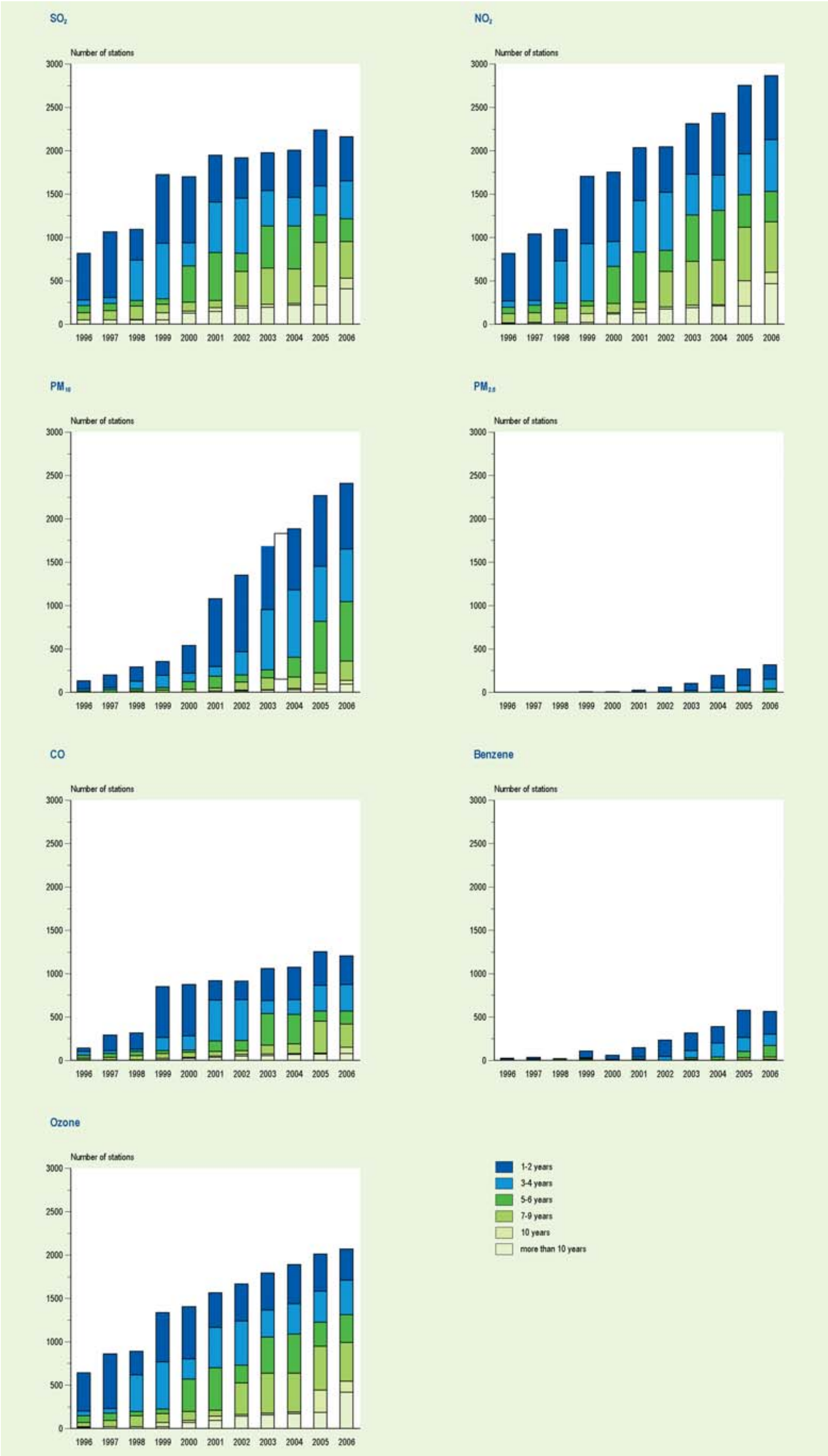


Figure 10 Number of stations with time series of 1-2, 3-4, 5-6, 7-9, 10 and more than 10 year ending in the year on the x-axis for several components.

2. STATE OF THE AIR QUALITY FOR SELECTED POLLUTANTS

2.1. Introduction

In addition to the more technical aspects of the 2007-data submission process, this section will present a preliminary evaluation of the 2006 air quality data. A more extensive discussion on the state of the European ambient air will be provided in the air pollution and related reports prepared by EEA and ETC/ACC (see for example EEA, 2007a).
This section will briefly describe the current (2006) air quality status; the long-term (1996-2006) and short-term (2001-2006) changes in concentrations are discussed. Focus will be on the pollutants listed in the first three Daughter Directives, that is, sulphur dioxide, nitrogen dioxide, PM_{10} and $PM_{2.5}$, carbon monoxide, benzene and ozone. The concentrations measured in 2006 will be compared with the limit and target values as set in the Daughter Directives, see *Table 6*.
Lead and the pollutants covered by the 4th Daughter Directive will be briefly discussed. As concentrations of these pollutants are frequently below the lower assessment threshold, other techniques then monitoring can be used for assessment of the air quality. This might be the reason that these pollutants are reported for a relatively small number of stations. A problem in analysing the data of these pollutants is that it is not known whether the pollutant has been measured on the PM_{10}-fraction (as described in the directives) or on another (undefined) size fraction.
The current air quality in relation to the limit or target values is presented in so-called distance-to-target graphs. In these graphs for each station type (rural background, (sub)urban background and traffic stations; industrial stations, stations with an unknown station type and background stations with un unknown type of area have not been included) the concentration averaged over all stations, the average concentration calculated only for stations where the limit (or target) value (LV; TV) is exceeded and the maximum observed value is presented. The number of stations in each category is given above the bars. The graphs are scaled in such a way that the concentration axis runs from zero to three times the limit or target value.
In the maps, distance-to-target graphs and in the trend graphs only stations having a data coverage of more than 75% have been included; for benzene the data coverage criterion has been set to 50% (see below). The trend analyses are further restricted to stations having 9 (5) valid data points in the 11 (6) year period.
Estimating a European wide trend in air quality is hampered by the fact that number and type of stations may differ widely between the European countries. In general terms, it can be stated that the stations included in the time series starting in 1996/1997 are located largely in the central -western part of Europe (Austria, Belgium, the Czech Republic, Switzerland, Germany, the Netherlands, and the UK) and in Spain. The time series for the shorter period (2001-2006) cover almost all countries delivering data to AIRBASE. The Balkan region, however, is not well covered. To illustrate these points, *Figure 11* shows the stations included in the NO2 trend analysis. Although the number of stations will differ for the other pollutants, the representativeness is broadly the same.
The emission data have been taken from the Annual European Community LRTAP Convention Emission Inventory 1990-2005 (EEA 2007b).

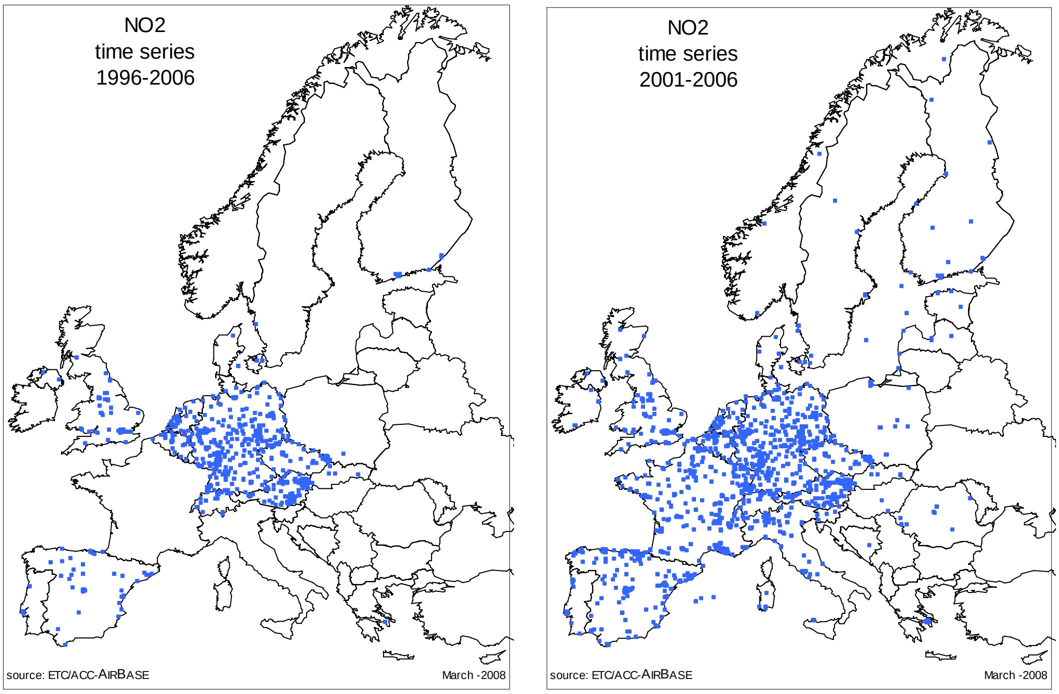


Figure 11. Stations used in the trend analyses for NO_2 over the period 1996-2006 (left) and 2001-2006 (right). These maps are illustrative for the spatial distribution of the station used in the long- and short-term trend analysis of the other pollutants.

Each pollutant section will be concluded with a table with AIRBASE data quality information. For each component the following aspects of the AIRBASE data quality will be described:

- Number of stations with data in 2006 (see *Table 1*).
- Number of stations with 2006-data coverage ≥75% and ≥90% (see also *Figure 1*). Data capture is a general measure for the performance of a monitoring system but not necessarily a sufficient indicator for the overall quality of the data set. For instance, a low data capture could result in an annual average with an acceptable quality, whereas the estimation of higher percentiles based on the same low data capture could lead to values with higher uncertainty.
- Geographical coverage or monitoring stations density in 2006 (see *Figures 2 until 9)*.
- Number of countries with time series[1] of 10 year ending in 2006 (see also *Figure 10*).
- Number of countries with time series of 5 year ending in 2006 (see also *Figure 10*).
- Number of stations with time series of 10 year ending in 2006 (see also *Figure 10*).
- Number of stations with time series of 5 year ending in 2006 (see also *Figure 10*).
- Average[2] length of time series regardless of the starting year (see *Table 5*) . The average length of time series doesn't give always a good picture. For example, if a country has new stations (with 1 year time series of data), the average length of time series can decrease substantially in comparison with the previous year. More detailed information on time series can be found in in table D "Information on time series in AirBase" in http://air-climate.eionet.europa.eu/databases/airbase/aqtables/eoi2006/index_html.

[1] The length of the time series in years have been calculated regardless of the data capture in a year. If there is a gap of one or more years, the maximum length of time series have been taken.
[2] Averaged over all stations in AirBase

Table 6 Limit and target values defined by the European Union for SO_2, NO_2, PM_{10}, Benzene, CO, O_3 , As, Cd, Ni and Benzo(a)pyrene to be met in 2006 unless indicated otherwise.

Parameter	period	Limit and target values (µg/m3)	No of allowed exceedances	Target data
SO_2 (1999/30/EC)				
Human health protection	Hourly average	350	24 hours/yr	
Human health protection	Daily average	125	3 days/yr	
Vegetation protection	Annual average	20		
Vegetation protection	winter average	20		
NO_2 (1999/30/EC)				
Human health protection	Hourly average	200	18 hours/yr	1 Jan 2010
Human health protection	Annual average	40		1 Jan 2010
PM_{10} (1999/30/EC)				
Human health protection	Daily average	50	35 days/yr	
Human health protection	Annual average	40		
Pb (1999/30/EC)				
Human health protection	Annual average	0.5		
CO (2000/69/EC)				
Human health protection	8h running average[a]	10 [b]		
Benzene (2000/69/EC)				
Human health protection	Annual average	5		1 Jan 2010
Ozone (2002/3/EC)				
Human health protection	8h running average[a]	120	25 days/yr	1 Jan 2010
Vegetation protection	Hourly averaged (growing season)	18 [c]		1 Jan 2010
Arsenic (2004/107/EC)				
Human health protection	Annual average	6[d]		01-12-2012
Cadmium (2004/107/EC)				
Human health protection	Annual average	5[d]		01-12-2012
Nickel (2004/107/EC)				
Human health protection	Annual average	20[d]		01-12-2012
Benzo(a)pyrene (2004/107/EC)				
Human health protection	Annual average	1[d]		01-12-2012

(a) daily maximum of 8h running averaged concentrations
(b) in mg/m3
(c) in (mg/m3).h
(d) in ng/m3

2.2. Sulphur dioxide (SO_2)

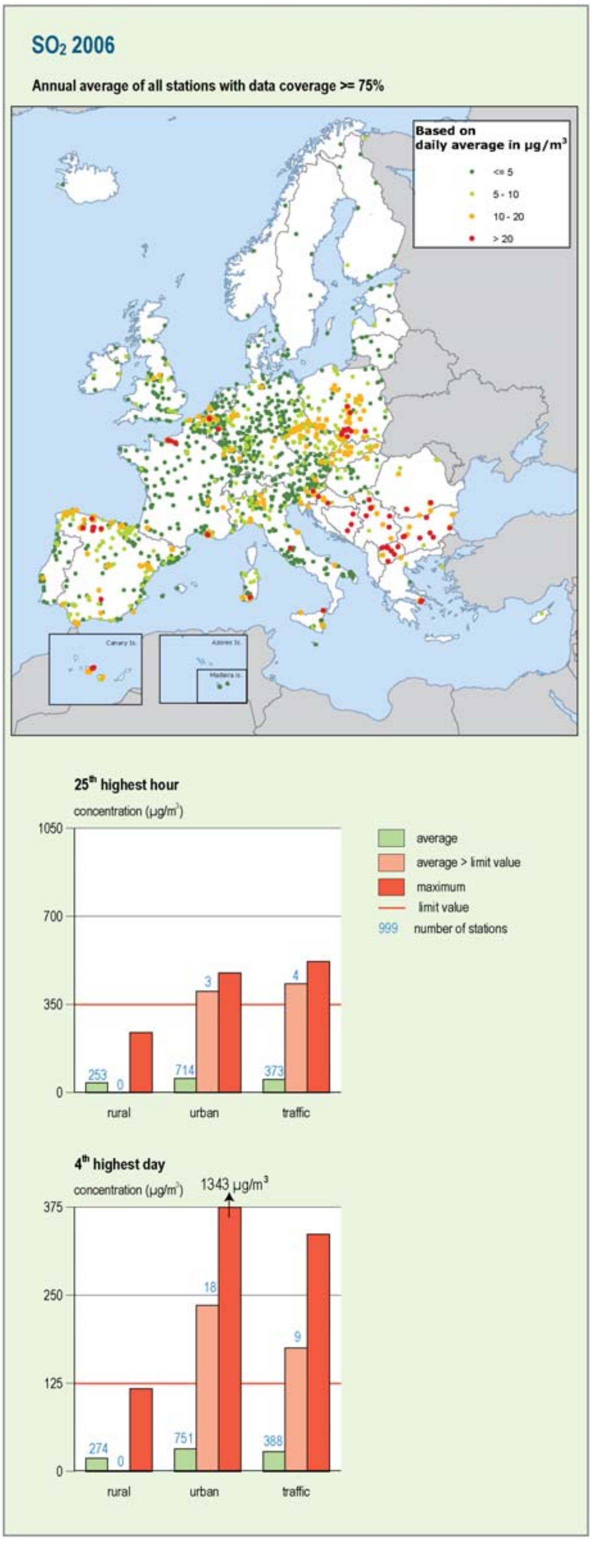


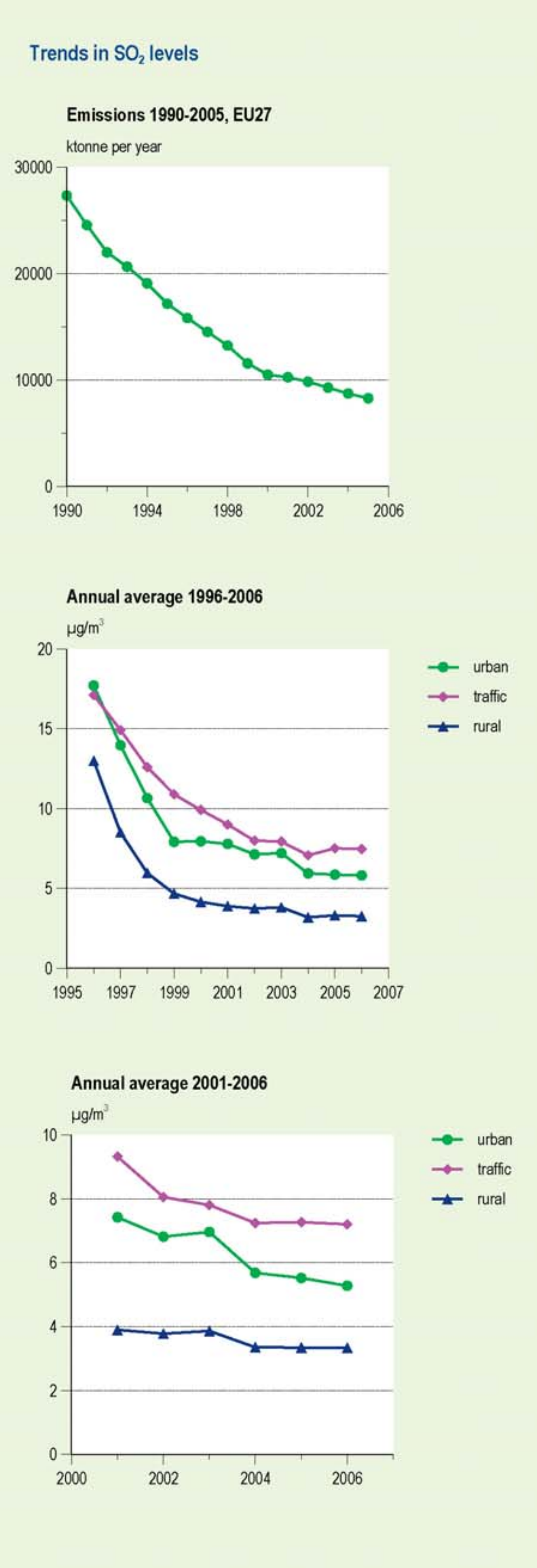
Figure 11. Annual mean map and distance-to-target graphs SO_2 in 2006.

Sources & effects

Man-made contributions to ambient SO_2 includes mainly the use of sulphur-containing fossil fuels and bio-fuels used for domestic heating, stationary power generation and for transport. Volcanoes are the most important natural sources.
Epidemiological studies published in the recent past provide suggestive evidence on the human health effects of sulphur dioxide; it causes irritation of the airways. SO_2 is a major precursor to particulate matter ($PM_{2.5}$) which is associated with significant health effects. Sulphur dioxide and its oxidation products contribute to acid deposition.

Status

At 1891 stations (slightly less than in 2005) SO_2 monitoring data fulfil the data coverage criteria of 75%. At half of them the annual mean is below 5 µg/m³. Annual mean values exceeding 20 µg/m³ have been observed at about 90 stations many of which are located in the Balkan-region, see map on the left above.
In the first daughter directive (EU, 1999) the EU has set limit values for the protection of human health (a daily average of 125 µg/m³ not to be exceeded on more than 3 days per year and an hourly average of 350 µg/m³ not to be exceeded on more than 24 days per year). The extent of exceedance of the SO_2 limit values is displayed in the figures on the left. Comparing the figures for the two limit values it is clear that the daily limit value is exceeded more than the hourly limit value. At rural background stations no exceedance is observed for either of the two limit values. For both urban background and traffic stations an exceedance is observed at less then 2.5% of the stations. The exceptionally high concentration of more than 1000 µg/m3 has been observed in Bor (Serbia). Concentrations at traffic stations are similar to the concentrations at (sub)urban background stations reflecting the small contribution of road traffic to the SO2 emissions. Note that the number of stations differs in both graphs as a limited number of stations report daily values only.
For protection of vegetation a limit value of 20 µg/m3 has been set both for the annual mean as well as for the winter mean. These limit values have been exceeded at a very few rural background stations: the annual mean (2006) has been

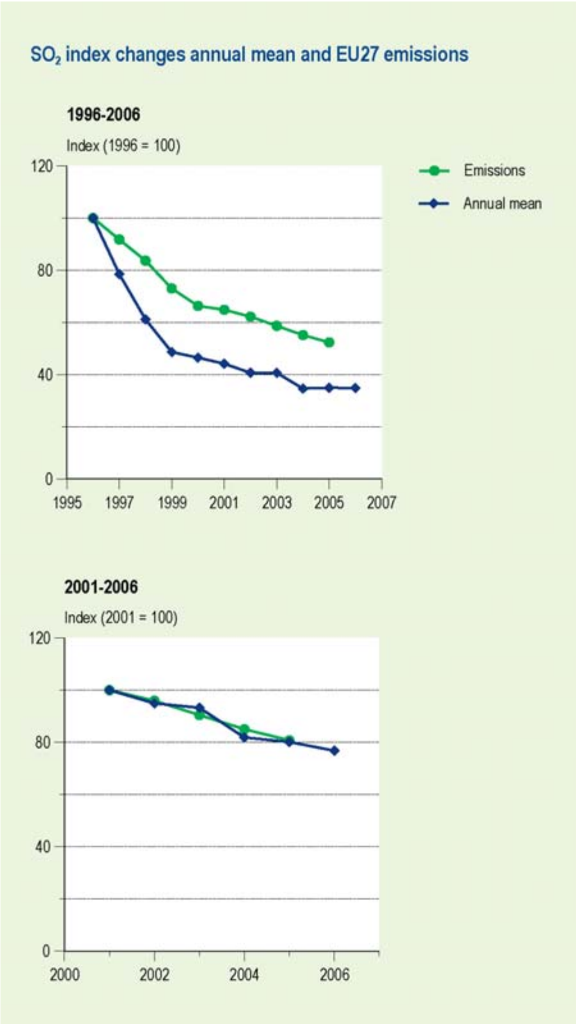


exceeded at one station in Bosnia and Herzegovina; the winter mean (October 2005 – March 2006) has been exceeded on three stations in Czech Republic (2) and Poland (1).

Trends in SO_2 levels

The SO_2 emissions have been reduced over the period 1990-2005 with 70% in the EU27 Member States. Over the periods 1996-2005 and 2001-2005 the decrease in emissions is 48% and 19% respectively. The changes in ambient concentrations are in agreement with this emission change. Over the period 1996 to 2006 the SO_2 concentrations (annual mean, averaged over all stations) have decreased by 65%. This is slightly more than the EU27 emission reduction in the corresponding period. However, as discussed in the introduction, the 1996-2006 trend is biased towards the situation in countries in NW Europe. The emission reduction in this region was larger than in the EU27 as a whole.

Figure 13. Trends in SO_2 air pollution, from top to bottom: i) emissions in EU27 Member States, 1990-2005; ii) annual mean concentrations averaged per station type over the period 1996-2006 (based on 592 stations); iii) similar as above but for the period 2001-2006, based on 1177 stations



The trend line over 1996-2006, representative for the NW part of Europe, shows a levelling off during the last years. The 2001-2006 trend line, more representative for the whole of Europe still shows some reduction. Over the last six years (2001-2006) a concentration reduction of 20% is found, in line with the emission reduction in EU27.

Figure 14. Trends in SO_2 air pollution: the indexed changes in emissions (green triangles) and annual mean concentrations averaged over all stations (blue diamonds) for the periods 1996-2006 and 2001-2006.

Some statistics on the availability of AirBase data

Nr. of countries with data in 2006	34		Nr. of countries with time series of 10 year ending in 2006	18
Nr. of stations with data in 2006	2165		Nr. of countries with time series of 5 year ending in 2006	29
Nr. of stations with data coverage = 75% in 2006	1891		Nr. of stations with time series of 10 year ending in 2006	529
Nr. of stations with data coverage = 90% in 2006	1590		Nr. of stations with time series of 5 year ending in 2006	1205
Station density in 2006	See figure 2		Average length of time series regardless of starting year	5,8

Table 7 AirBase statistics SO_2

2.3. Nitrogen dioxide (NO_2)

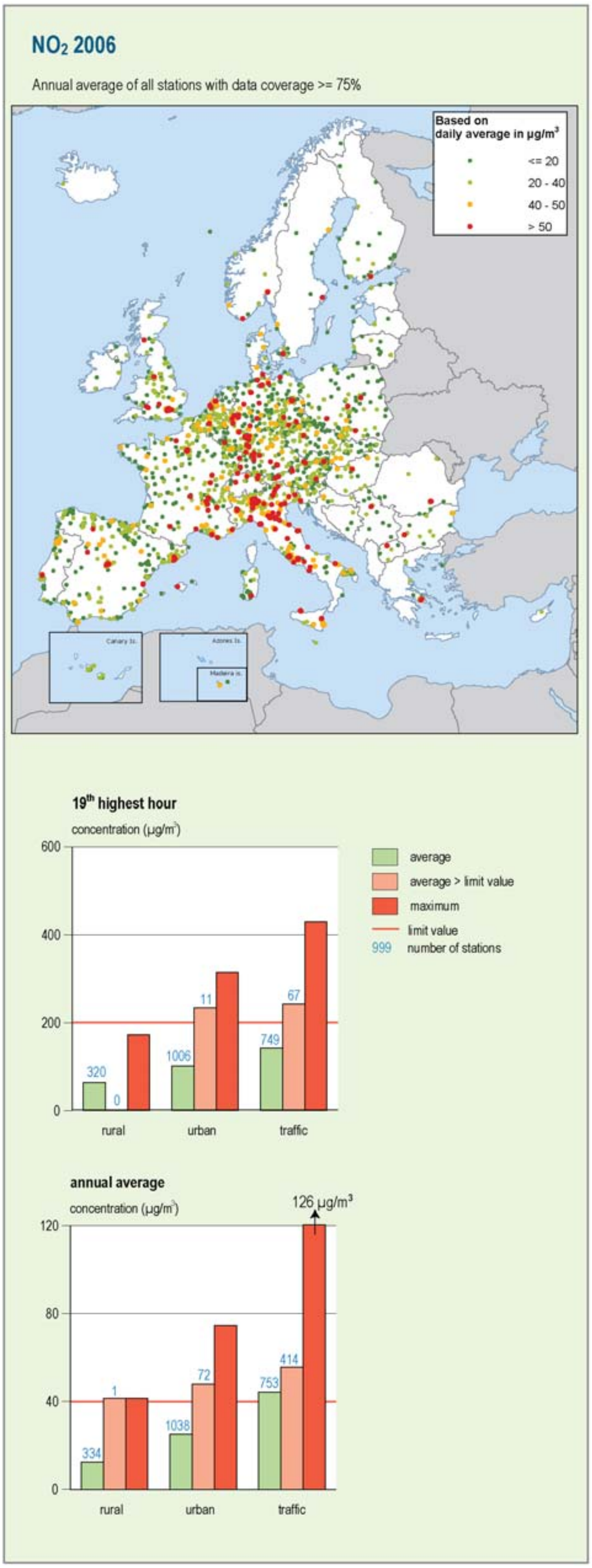


Figure 15. Annual mean map and distance-to-target graphs NO_2 in 2006.

Sources & effects

Nitrogen dioxide is a reactive gas that is mainly formed in the ambient air by oxidation of nitric oxide (NO). High temperature combustion processes (such as those occurring in car engines and power plants) are the major sources of nitrogen oxides, the term used to describe the sum of NO and NO_2. Nitrogen monoxide is the main component of the NOx emission. A small part is directly emitted as NO_2. There are clear indications that for traffic emissions the direct NO_2 fraction is increasing due to increased penetration of diesel vehicles, especially those with particle filter. This may lead to more frequent breeching of the NO_2 limit values in traffic hotspot situations. Health effects of nitrogen dioxide are seen both during short term exposures (changes in lung function in susceptible groups) and long-term exposure (increased susceptibility to respiratory infection). It should be noted that as NO_2 is highly correlated with other pollutants (in particular PM) it is very difficult to differentiate the effects of nitrogen dioxide from those of other pollutants in epidemiological studies. Nitrogen oxides play a major role in the formation of ozone and secondary aerosol contributing to PM_{10} and $PM_{2.5}$ concentration. They further contribute to acidification and eutrophication.

Status

At 2534 stations the NO_2 daily values fulfil the data coverage criteria of 75%; for hourly values the criteria is fulfilled for 2472 stations. Compared to 2005 the number of stations fulfilling these criteria increased with about 5%. In the first daughter directive (EU, 1999) the EU has set limit values for the protection of human health (an annual average of 40 µg/m³ and an hourly average of 200 µg/m³ not to be exceeded on more than 18 hours per year). The extent of exceedance of the NO_2 limit values is displayed in the figures on the left side. Comparing the figures it is clear that the annual limit value is exceeded to a larger extent than the hourly limit value. At rural background station no exceedance of the hourly limit value is observed. For urban background and traffic stations exceedances are observed at 1% and 9% of the stations, respectively. Exceedance of the annual limit value is not only more frequent (at 7% and 55% of the urban background and traffic stations, respectively) but also more severe: the concentration at traffic stations where an exceedance is observed is on the average 20% above the hourly limit value but 39% above the annual limit value.

Trends in NO_2 levels

The NOx emissions have been reduced over the period 1990-2005 with 34% in the EU27 Member States. Over the periods 1996-2005 and 2001-2005 the decrease in emissions is 21% and 8% respectively. The changes in ambient NO_2 concentrations depend on the type of station. At rural background stations, the 1996-2006 concentration change (- 20%) is in line with the emission change. At more polluted stations the decrease in NO_2 is less: 16% and 2% reduction at urban background and traffic stations, respectively. Close to NOx sources a similar reduction in NOx emissions and corresponding NOx concentrations is not seen in the NO_2 concentrations as the NO_2/NOx ratio increases due to ozone oxidation of the available NO. In rural situations NO concentrations are very low and NOx and NO_2 concentrations changes are more parallel. A second reason for the small NO_2 reduction at traffic sites is the increase of direct emission of NO_2 by diesel cars. There are indications of a relative increase in direct emissions of NO2 from light duty vehicles (Carslaw, 2005; Carslaw *et al.*, 2007; Hueglin *et al.*, 2006). Diesel engine particulate filters actally increase NO2 during the process of removing soot from the exhaust emissions. Notwithstanding the small (8%) reduction in NOx emissions, the annual averaged NO_2 concentrations do not show a distinct trend over the last six years (2001-2006).

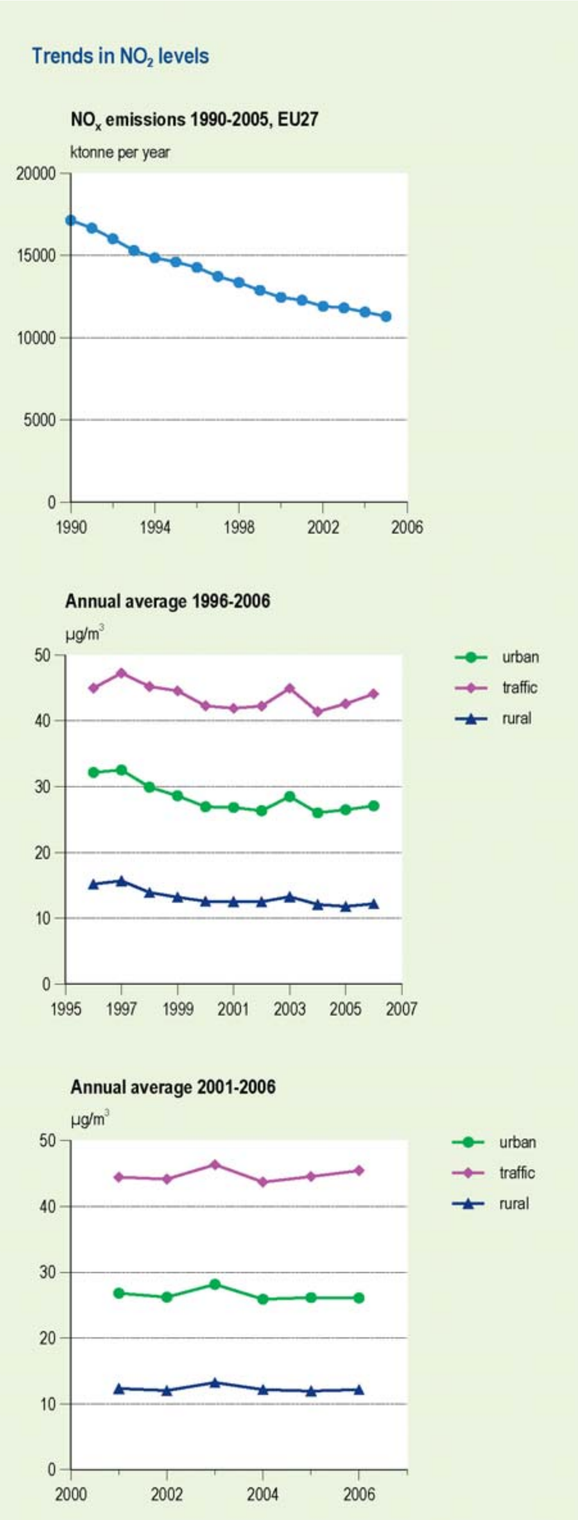


Figure 16. Trends in NO_2 air quality (based on annual mean concentrations) over the period 1996-2006 (based on 640 stations) and over 2001-2005 (based on 1465 stations).

Some statistics on the availability of AIRBASE data

Nr. of countries with data in 2006	35		Nr. of countries with time series of 10 year ending in 2006	18
Nr. of stations with data in 2006	2870		Nr. of countries with time series of 5 year ending in 2006	28
Nr. of stations with data coverage = 75% in 2006	2534		Nr. of stations with time series of 10 year ending in 2006	600
Nr. of stations with data coverage = 90% in 2006	2117		Nr. of stations with time series of 5 year ending in 2006	1525
Station density in 2006	See figure 3		Average length of time series regardless of starting year	5,6

Table 8 AIRBASE statistics NO_2

2.4. Particulate Matter (PM_{10} and $PM_{2.5}$)

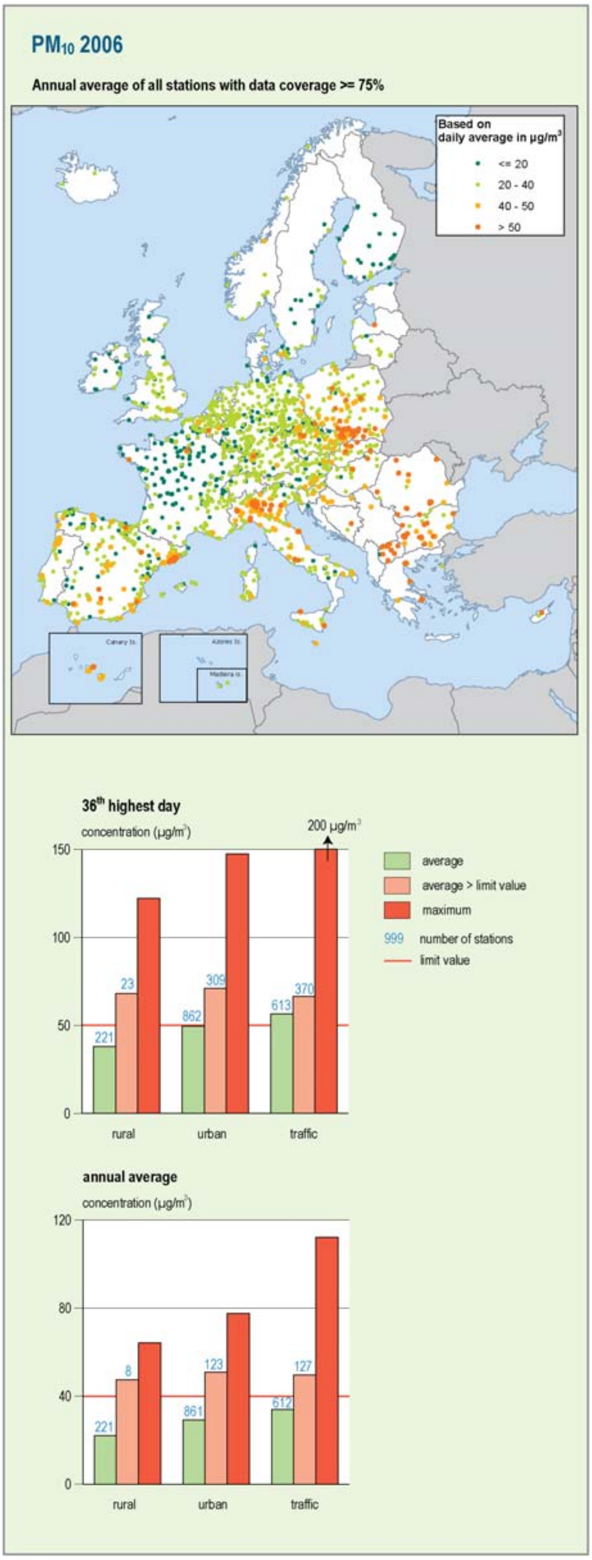


Figure 17. Annual mean map and distance-to-target graphs PM_{10} in 2006.

Sources & effects

Particulate matter is the general term used for a mixture of solid particles and liquid droplets with a wide range in size and chemical composition. $PM_{2.5}$ refers to fine particle that have a diameter of 2.5 micrometer or less. PM_{10} refers to the particles with a diameter of 10 micrometer or less. PM is either emitted directly (primary particles) or formed in the atmosphere from primary gaseous emissions (secondary particles, most important precursors are sulphur dioxide, nitrogen oxides, ammonia and organic compounds). PM is from natural (e.g. sea salt, Sahara dust, pollen, volcanic emissions) or anthropogenic origin such as thermal power generation, incineration and vehicles. In cities vehicle exhaust and road dust are important sources. Epidemiological studies indicate that the most severe health effects from exposure to air pollution must be attributed to the particulate matter and, in a lesser extent, to ozone (see section 3.7). It is suggested that for both pollutants there is no safe level: even at concentrations below current air quality guidelines they may pose a health risk (WHO, 2006).

Health effects of fine particulate matter (PM) are caused by their inhalation and penetration into the lungs. Both chemical and physical interactions with lung tissues can induce irritation or damage. Since finer PM are more able to penetrate the lungs, the size of the particles is of significance. The current scientific understanding is that mortality effects of PM are mainly associated with the $PM_{2.5}$ fraction which represents 40 – 80% of the PM_{10}-mass (Larssen and de Leeuw, 2007). However, health effects are seen with both the finer sub-2.5 µm and the coarser 2.5-10 µm fractions of PM_{10}. Whilst evidence is growing that finer size fractions are perhaps most important, ambient air quality measurements and emission data at present are often only available for PM_{10}. Different methods are in use from the routine monitoring of PM_{10}. Some of these methods are very sensitive for sampling artefacts. The first daughter directive states that when a non-reference method is applied, equivalence with the reference method has to be ensured, if necessary, by applying a correction factor.

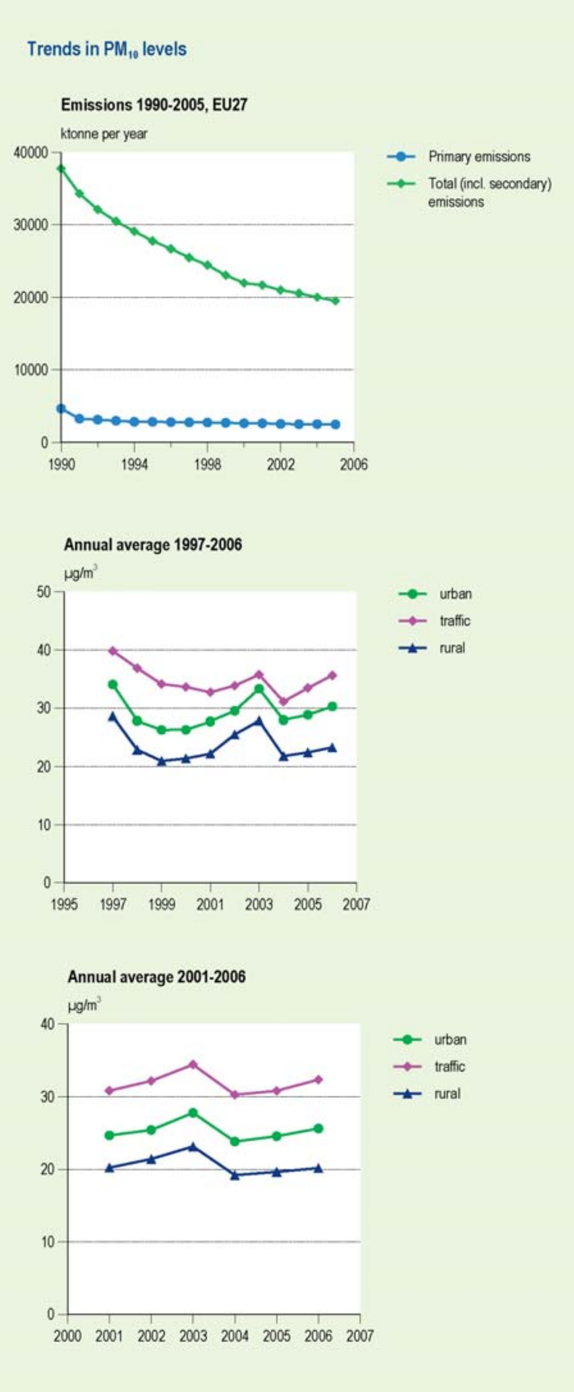


Figure 18. Trends s in PM_{10} air pollution, from top to bottom: i) Changes in emissions of primary PM_{10} and total emissions (primary plus secondary) in the EU27 Member States ii) Changes in PM_{10} air quality (based on annual mean concentrations) over the period 1997-2006 (based on 186 stations) and iii) over 2001-2006 (based on 864 stations).

However, it can not be excluded that incidentally the data obtained by a non-reference method has not been or is not properly corrected prior to submission to AIRBASE. This may lead to a systematic underestimation for the stations concerned. Overview of PM measuring methods and correction factors are available from the ETC/ACC web site (Buijsman and de Leeuw 2004, de Leeuw 2005).

Status

At 2017 stations the PM_{10} daily values fulfil the data coverage criteria of 75%.
In the first daughter directive the EU has set limit values for the protection of human health (an annual average of 40 µg/m³ and a daily average of 50 µg/m³ not to be exceeded on more than 35 days per year). The extent of exceedance of the PM_{10} limit values is displayed in the distance-to-target graphs. Comparing the figures it is clear that the daily limit value is exceeded to a larger extent than the annual limit value. Exceedance of both limit values is observed at all types of stations with increasing numbers from rural background to urban background to traffic stations. The daily limit value is frequently exceeded at urban background stations (more than 35%) and at traffic stations (more than 60%).

Trends in PM_{10} levels

The total PM_{10} emissions have been reduced over the period 1990-2005 with 48% in the EU27 Member States. The secondary PM-precursor emissions are calculated as a weighted sum of the emissions of PM-precursors SO_2, NO_x and NH_3 (see de Leeuw 2002).This reduction is largely due to a reduction in SO_2 emissions. The primary PM_{10} emissions have been reduced by 47% over this period. Over the period 1997-2005 and 2001-2005 the decrease in total emissions is 23% and 10%, respectively. The limited number of stations operational during the period 1997-2005 and the large meteorologically induced inter-year variations over the entire period precludes any firm conclusion about a possible trend. Although the number of stations providing data during the last six year period has been more than doubled, a clear European-wide trend is not observed. However, the short-term and medium-term trends as shown in the graphs above indicate that, in contrast to the steady decrease in emissions, the concentrations are not decreasing. A more detailed analysis of data from the UK (Harrison et al., 2008) shows also a flat temporal trend while there are indication that the concentration in London of primary PM10 is increasing (Fuller and Green, 2006).

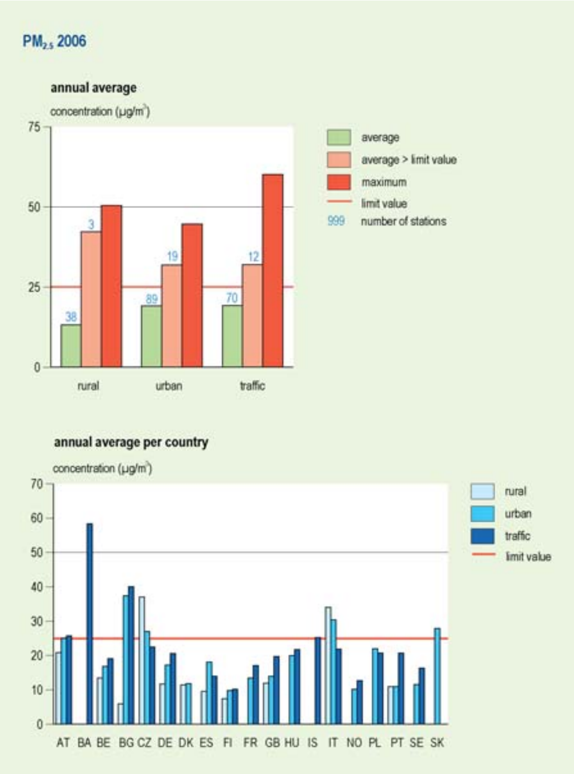


Figure 19. From top to bottom: i) Distance-to-target graph $PM_{2.5}$ in 2006 and ii) measured $PM_{2.5}$ concentrations, 2006 (µg/m³, annual average) for several countries. Each bar represents the average concentrations for each station type

PM2.5 concentrations

The number of operational $PM_{2.5}$ stations is growing but still limited. For 2006 there are 217 stations fulfilling the criteria of more than 75% data coverage. Although the spatial coverage of monitoring stations is presently insufficient to assess variations across Europe (20 countries (17 Member States)[1] report data for one or more station) some comparison is possible between observations at the increasing numbers of monitoring stations reporting $PM_{2.5}$ and the 25 µg/m³ limit value of the new Air Quality Directive [Council approved 2nd reading, PE-CONS 3696/07]. This limit value has to be met by 2015; for 2010 a target value of 25 µg/m³ has been set.
As many current $PM_{2.5}$ monitor instruments significantly underestimate concentrations mass loss during sampling, real $PM_{2.5}$ concentrations would be higher than those shown.
The indication is that hot-spot (traffic-related) locations may well exceed the limit value.
Concentrations generally increase from rural background to urban background to traffic locations, in accordance with increasing proximity to PM sources, see the distance-to-target graph. The lower graph shows that the 2015 limit value is currently exceeded in seven of the 20 reporting countries.

Some statistics on the availability of AIRBASE data

Nr. of countries with data in 2006	35		Nr. of countries with time series of 10 year ending in 2006	10
Nr. of stations with data in 2006	2423		Nr. of countries with time series of 5 year ending in 2006	24
Nr. of stations with data coverage = 75% in 2006	2017		Nr. of stations with time series of 10 year ending in 2006	137
Nr. of stations with data coverage = 90% in 2006	1729		Nr. of stations with time series of 5 year ending in 2006	1046
Station density in 2006	See figure 3		Average length of time series regardless of starting year	4,1

Table 9 AIRBASE statistics PM_{10}

Nr. of countries with data in 2006	22		Nr. of stations with data coverage = 75% in 2006	219
Nr. of stations with data in 2006	320		Nr. of stations with data coverage = 90% in 2006	156
Station density in 2006	See figure 4		Average length of time series regardless of starting year	2,6

Table 10 AIRBASE statistics $PM_{2.5}$

[1] In *Table1* there are 22 countries (19 Member States) with $PM_{2.5}$ 2006 data, but Luxembourg is not yet included in figure 19 because they delivered the data after creation of this figure; Romania is also not included because the data don't fulfill the 75% data coverage criterium.

2.5. Carbon monoxide (CO)

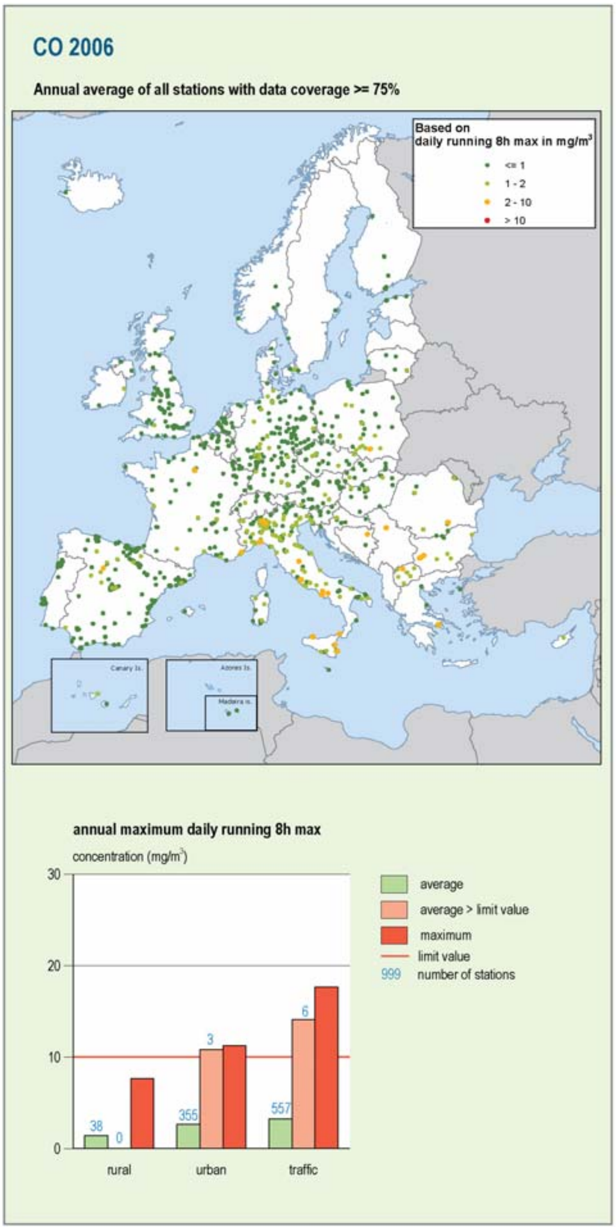


Figure 20. Annual mean map and distance-to-target graph CO in 2006

Sources & effects

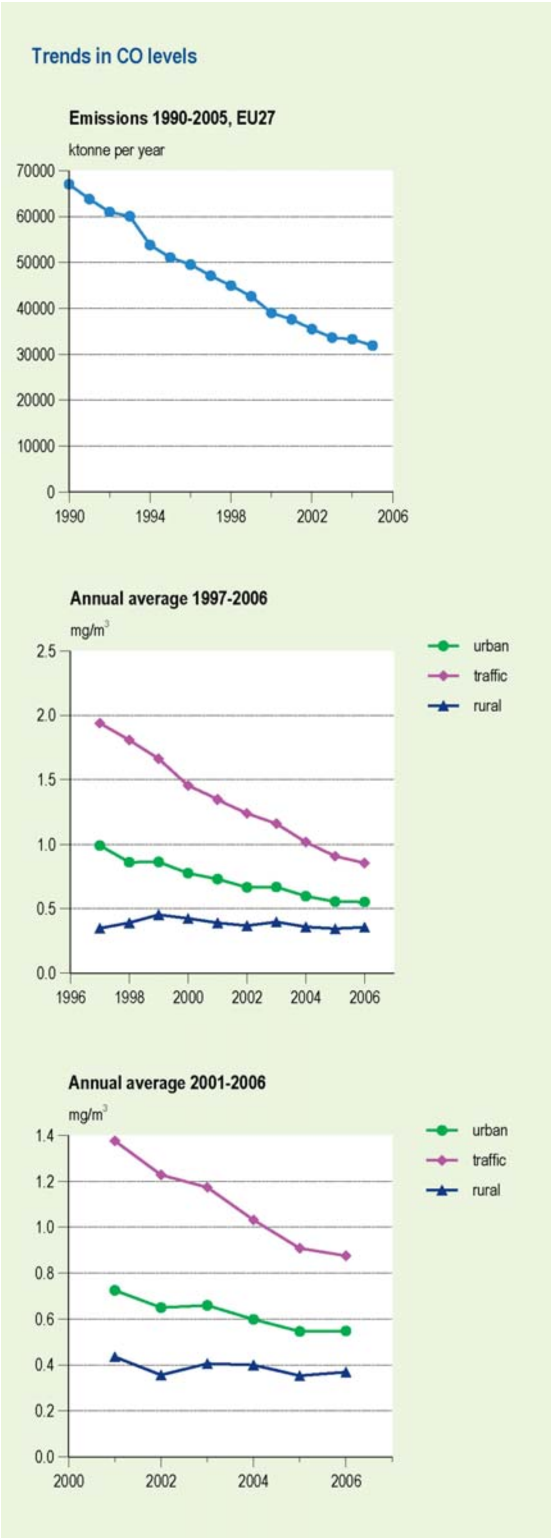
Carbon monoxide (CO) is a colourless, odourless gas that is formed during the incomplete combustion of fossil fuels and biofuels. The contribution of road transport to the CO emissions in EU27 decreases from 53% in 1990 to 38% in 2005; the remaining is mainly emitted during energy production. The CO concentrations tend to vary with the traffic patterns during the day; the highest CO levels are found in urban areas, typically during rush hours at traffic locations. The atmospheric lifetime of CO is about 3 months. It is slowly oxidized to carbon dioxide. During this oxidation process ozone is formed and CO contributes to the hemispheric ozone background concentrations.

Carbon monoxide enters the body through the lungs. In the blood it is strongly bound to haemoglobin and thereby it reduces the oxygen delivery to the body's organs and tissues. Those who suffer from cardiovascular disease are the most sensitive towards CO exposure.

Status

At 1065 stations the CO daily maximum 8-hour mean values fulfil the data coverage criteria of 75%.

In the second daughter directive the EU has set limit values for the protection of human health: the CO daily maximum 8-hour mean values may not exceed 10 mg/m^3. This level is not exceeded at the few operational rural background stations. Exceedances are observed at about 1% and at 2% of the urban background and traffic stations. Exceedances are observed in a number of countries: Bosnia and Herzegovina, Bulgaria, FYR of Macendonia, Italy, Portugal, Romania and Serbia.



Trends in CO levels

The CO emissions have been halved over the period 1990-2005 in the EU27 Member States. Over the periods 1997-2005 and 2001-2005 the decrease in emissions is 32% and 15% respectively. The changes in ambient concentrations are in agreement with this. On average the CO concentrations (annual mean of 8h daily maximum values) have decreased at traffic and urban background stations, relatively close to the sources, with 45-55% from 1997-2006.
Since 1999 a consistent set of 11 rural background stations has reported CO concentrations under the EoI. An averaged decrease of about 20% has been observed at these stations. With an atmospheric reference time of about 3 months the rural concentrations will to a large extent be determined by sources outside the EU27. Over the last six years (2001-2006) a 35% reduction is observed at traffic stations; in the urban background the reduction is about 25%.

Figure 21. Trends in CO air pollution, from top to bottom: i) emissions in EU27 Member States, 1990-2005; ii) Changes in CO air quality (based on annual mean concentrations) over the period 1997-2006 (based on 331 stations) ; iii) similar as above but for the period 2001-2006 (based on 579 stations).

Some statistics on the availability of AIRBASE data

Nr. of countries with data in 2006	34		Nr. of stations with data coverage = 75% in 2006	1065
Nr. of stations with data in 2006	1209		Nr. of stations with data coverage = 90% in 2006	858
Station density in 2006	See figure 7		Average length of time series regardless of starting year	4,9

Table 11 AIRBASE statistics CO

2.6. Benzene

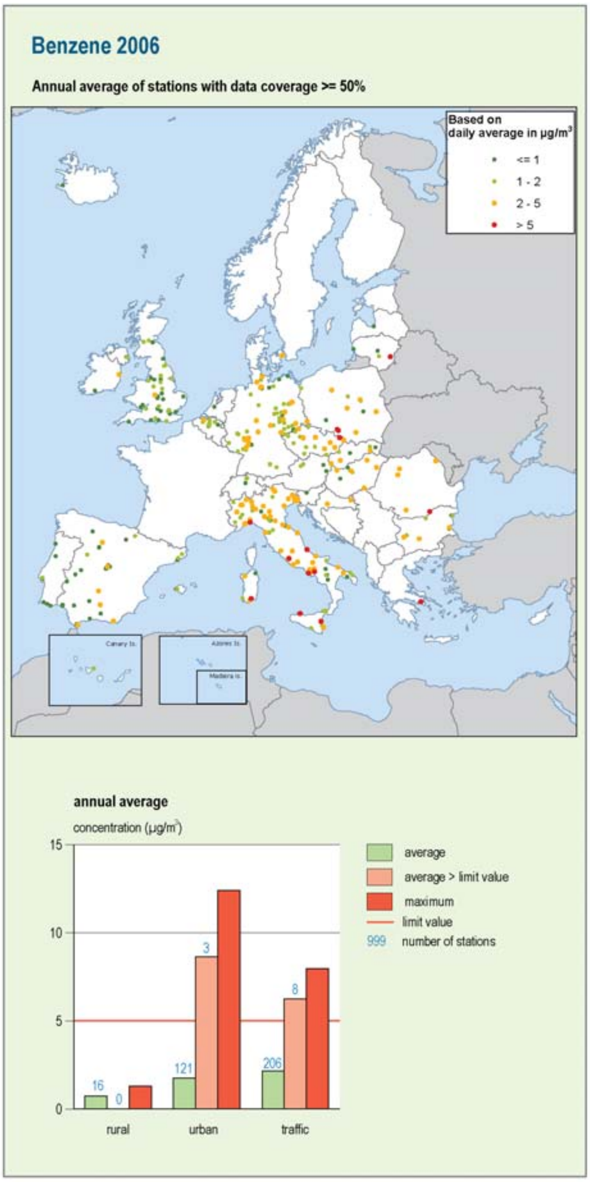


Figure 22. Annual mean map and distance-to-target graphBenzene in 2006

Sources & effects

Inhalation is the dominant pathway for benzene exposure in humans, food and water consumption being only a minor source. Smoking is a large source of personal exposure. The most significant adverse effects from prolonged exposure are haematotoxicity, genotoxicity and carcinogenicity. Chronic exposure to benzene can depress bone marrow, and cause haematological effects such as decreased red and white blood cell count in workers occupationally exposed to high concentrations.

Incomplete burning from combustion is the most significant source of the carcinogenic pollutant benzene. It is an additive to petrol with a maximum concentration of 1% v/v. At the European scale, 80-85% of benzene emissions are due to vehicular traffic. This results from both the benzene content of the fuel and partial combustion of the petrol. A further 5% comes from the handling, distribution and storage of petrol and approximately 1% comes from oil refining. Emissions also come from benzene-producing and handling industries. In general the contributions of domestic heating are small (about 5%) but with sharp geographic patterns. Wood combustion might be an important local source of benzene (Hellen et al., 2008). In Sweden the domestic contribution reaches over 50%. Removal of benzene from the atmosphere is mainly by reaction with the hydroxyl (OH) radical. Photo-oxidation does contribute to ozone formation, although benzene reactivity is relatively low. A lifetime of several days at representative tropospheric OH- concentrations is sufficient for benzene to be transported over long distances.

Status

Benzene is not always measured continuously. For discontinuous measurements a lower data coverage than 75% will not largely increase the uncertainties in the annual mean values as long as the measurements take place randomly spread over the year (Working group on benzene, 1998). For this reason we have applied a data coverage criterion of better than 50% This criterion is fulfilled in 2006 at 408 stations measuring benzene.

The second Daughter Directive (EC, 2000) set an annual average concentration limit value of 5 µg/m^3 for benzene in ambient air, to be met by 2010. Including the margin of tolerance, the annual mean concentrations may not exceed 9 µg/m^3 in 2006. At rural background stations no exceedance of the limit value is observed. Exceedance of the limit value is observed at three urban background stations and at ten traffic stations. Exceedances of the limit value plus margin of tolerance have been reported for one urban background station (Poland) and one industrial station (Czech Republic).

Trends in benzene levels

Recent summaries of the benzene emissions in the EU27 countries do not exist. For a limited number of countries emission data representative for the last decade of the previous century is presented in the position paper on benzene in support to the preparation of the second daughter directive. More recent, expert-based emission data have been prepared for the Auto Oil Programme (EEA, 2001). These studies indicate decreasing benzene emissions but a further quantification is not possible. Most important control methods to reduce benzene emissions include the reduction of benzene content of petrol to 1% in 2000, the introduction of catalytic converters and vapour recovery of petrol deliveries.

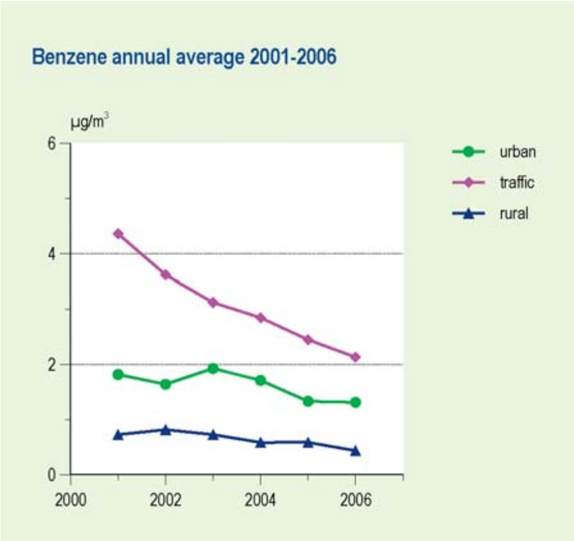


Figure 23. Trends in benzene air quality (based on annual mean concentrations) over the period 2001-2006 (base on 140 stations).

Up to 2001 benzene monitoring data has been submitted for less then 100 stations. Since 2001 onwards the number of stations annually reporting data might be as large as 500 although at a large number of the stations the data coverage criteria of 50% have not been met. For 80 traffic stations a complete time series (at least five out of the six years with valid data) has been reported over the period 2001 – 2006. On the average these traffic station show a reduction by 50% in this period. The reduction at traffic stations is in relative and absolute terms larger than for the urban or rural background stations; this confirms the large contribution from road traffic to the benzene emissions.

Some statistics on the availability of AIRBASE data

Nr. of countries with data in 2006	26		Nr. of stations with data coverage = 75% in 2006	295
Nr. of stations with data in 2006	569		Nr. of stations with data coverage = 90% in 2006	183
Station density in 2006	See figure 8		Average length of time series regardless of starting year	3

Table 12 AIRBASE statistics Benzene

2.7. Ozone (O_3)

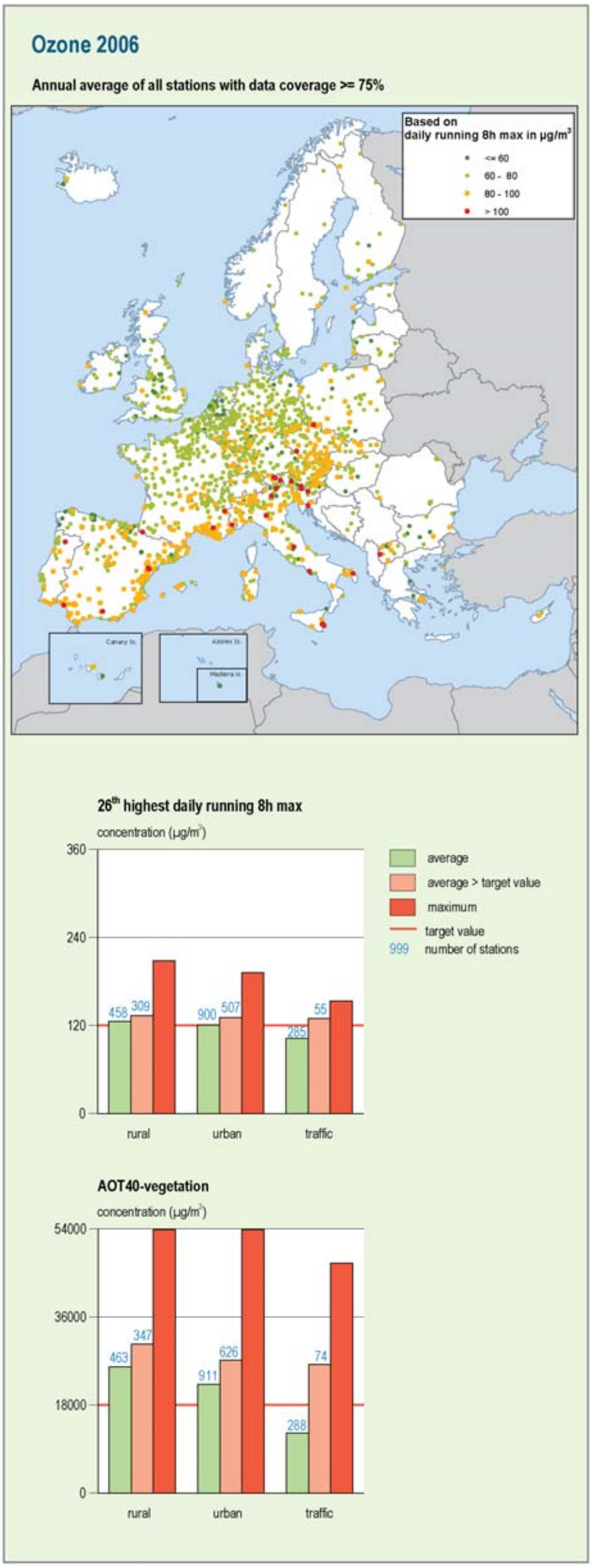


Figure 24. Annual mean map and distance-to-target graphs O_3 in 2006

Sources & effects

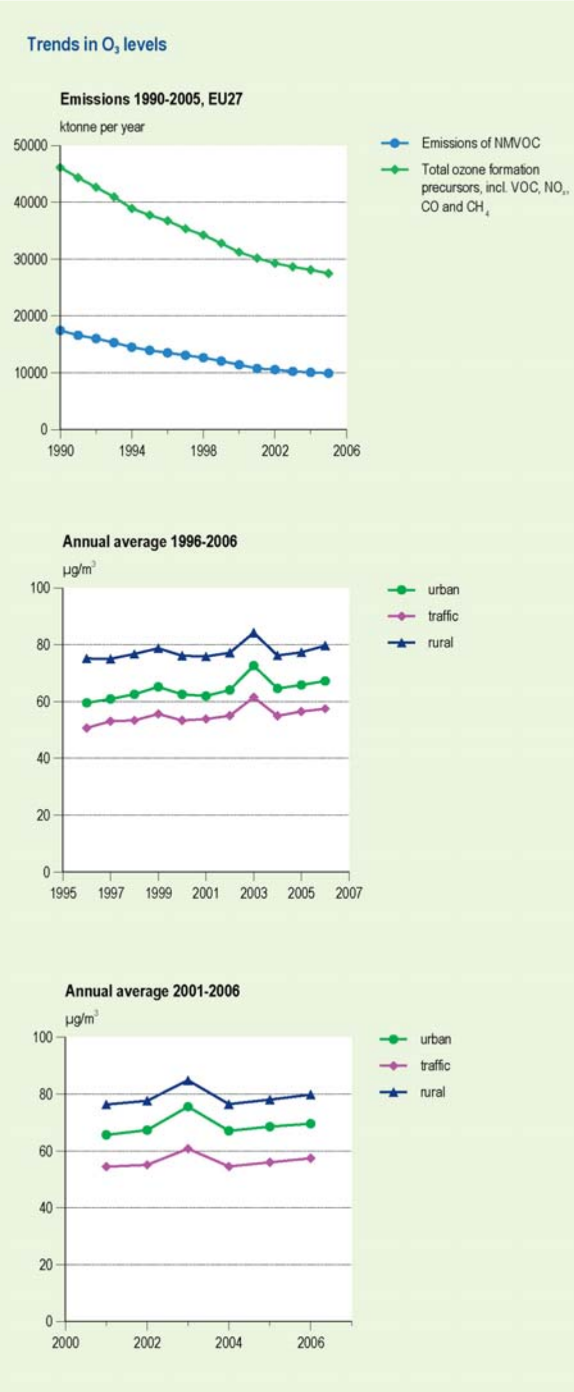
Ozone is not directly emitted into the atmosphere but formed by photochemical reactions of volatile organic compounds (VOC) and nitrogen oxides. Sunlight and high temperature favours ozone formation. NOx play a complex role in the ozone chemistry: close to NOx sources it will deplete ozone due to the scavenging reaction between the freshly emitted nitrogen monoxide and ozone. Farther away from sources, NOx is indispensable in the regeneration of the OH-radical, the key species in the oxidation chain process. Evaporation losses are the main source of VOC emissions. Traffic, solvent usage and refineries are the largest anthropogenic sources.

Short-term studies show that O_3 has adverse health effects, especially in the summer, on pulmonary function, lung inflammation, lung permeability, respiratory symptoms, increased medication usage, morbidity and mortality. Long-term effects are less clear but evidence for the chronic effects of ozone is supported by human and experimental information. Epidemiological evidence of chronic effects is less conclusive, owing mostly to an absence of studies designed specifically to address this question and inherent limitations in characterizing exposure. The studies with the most efficient approaches and more individual assignment of exposure provide new evidence for chronic effects of ozone on small airway function and possibly on asthma (WHO, 2006)

Status

At 1874 stations the ozone daily values fulfil the data coverage criteria of 75%. In the third daughter directive the EU has set target values for the protection of human health (the daily maximum of the running 8-hour mean values may not exceed 120 µg/m^3 on more than 25 days per year) and for vegetation (18000 (µg/m^3).h as AOT40 value).

The health related target is widely exceeded at more than two thirds of the rural background stations. In urban area about 45% of the station is not in compliance with the target. The AOT40 value averaged over all rural background stations is40% above the target. At 75% of the rural background stations the target is exceeded, on average concentrations are 70% above target. Even at two thirds of the urban background stations and a quarter of the traffic station the AOT40-target is exceeded. The maximum observed AOT40 levels are more than a factor 2-4 higher than the target value: 75000, 63000 and 47000 (µg/m^3).h at rural background, urban background and traffic stations, respectively.



Trends in ozone levels

The emissions of ozone precursors, weighted according to their contribution in ozone formation (de Leeuw 2002) have been reduced over the period 1990-2005 with about 40% in the EU27 Member States. Over the periods 1996-2005 and 2001-2005 the decrease in total emissions is 25% and 9% respectively. The development of the ozone concentrations during the last decade are not in line with these emission changes. Neglecting the high concentrations in 2003, caused by the extremely favourable conditions for ozone formation in that year in most of Europe, the rural data show no trend at all while the traffic and urban background stations suggest some increasing tendency. This increase can be explained by less ozone depletion due to decreasing NOx emissions. The constant background levels are the net result of a number of possible processes: the increase in hemispheric background concentrations, less ozone deposition during the (more frequent) dry periods during the summer, increased ozone formation due to higher temperatures, less ozone formation due to emissions reduction. Climatological changes in the large-scale circulation patterns over Europe might also play a role.

Figure 25. Trends in O_3 air pollution, from top to bottom: i) Emissions of VOC and TOFP (total ozone formation precursors, including VOC, NOx, CO and CH4) in the EU27 Member States, ii) Changes in ozone air quality (based on annual mean concentrations) over the period 1996-2006 (based on 586 stations) and iii) over 2001-2006 (based on 1259 stations)

Some statistics on the availability of AIRBASE data

Nr. of countries with data in 2006	35		Nr. of countries with time series of 10 year ending in 2006	17
Nr. of stations with data in 2006	2074		Nr. of countries with time series of 5 year ending in 2006	25
Nr. of stations with data coverage = 75% in 2006	1874		Nr. of stations with time series of 10 year ending in 2006	547
Nr. of stations with data coverage = 90% in 2006	1653		Nr. of stations with time series of 5 year ending in 2006	1311
Station density in 2006	See figure 9		Average length of time series regardless of starting year	6,2

Table 13 AIRBASE statistics O_3

2.8. Trend in SO_2, NO_2, PM_{10}, CO, Benzene and O_3 concentrations at traffic stations

At traffic locations clear differences in recent trends are observed for the various pollutants. The graph below shows a steady decrease in the (indexed) concentrations of benzene (annual mean), SO2 (annual mean) and CO (annual mean of 8-h running daily maximum). The CO concentration trend mimics the trend in road transport emissions of CO: a decrease of 30-35% over the period 2001-2005. For SO2 the trend observed at traffic stations parallels the trend observed at (sub)urban background stations. The contribution of road traffic to the SO2 emissions is less than 1.5% resulting in minor difference between concentrations at traffic hot-spot situations and the (sub)urban background. A direct comparison of the benzene concentration trend with emission data is not possible due to lack of information. A strong reduction in benzene levels has been observed prior to 2001 as the result of limiting the benzene fraction in gasoline. The benzene emissions from road transport are still reducing due to the penetration of cars complying with the the latest and most stringent emission standards. In 2001 about 70% of the petrol cars was fitted with a catalytic converter in EU15. In 2005 this increased to about 85%; nearly 40% of the gasoline passenger cars is in compliance with the EURO-3 standards (Siannouli & Mellios, 2006).
In contrast to these three pollutants the concentrations of NO2 (annual mean), PM10 (annual mean) and ozone (annual mean of 8h-running daily maximum) are virtually constant. Possible explanations for the absence of a NO2 concentration trend while the NOx road transport emissions decreased with 16% between 2001 and 2005, are given in the section on NO2 .
PM10 concentrations at traffic locations are slightly higher than in the urban background; the largest contributions to the concentration at street level are from the urban and rural background. The road transport emissions of primary PM10 were reduced by about 10% between 2001-2005 but contribute only 15% to the total primary PM10 emissions. No differences in trends at traffic and urban background stations are therefore expected. Why there is no clear trend at any of the station types is still an open question (Harrison et al., 2008).
Several reasons may explain the absence of a trend in ozone levels: the absence of a trend in the rural background levels and the decreasing NOx emission of road transport resulting in less depletion by NO-titration, will be the most important reasons at the local scale.

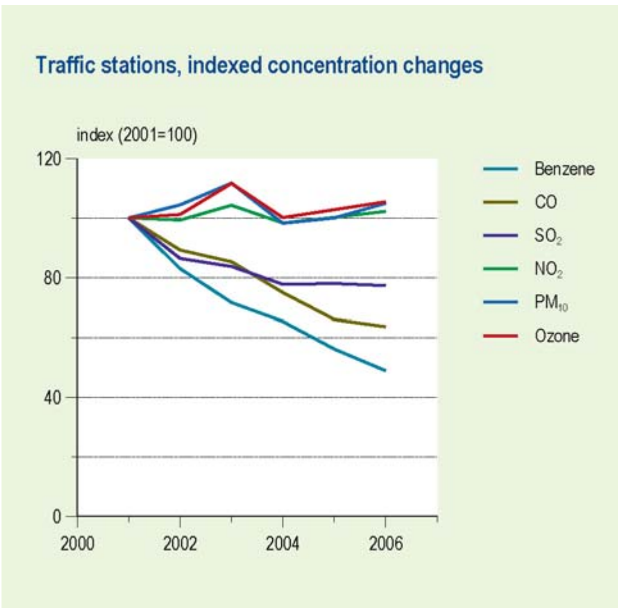


Figure 26. Indexed concentration changes on traffic stations; concentrations are annual means, based on daily averages for SO_2, NO_2, PM_{10} and Benzene, and based on daily running 8h maximum for CO and O_3

2.9. Heavy metals and benzo(a)pyrene

Lead

Exposure to lead is mainly by inhalation and by ingestion via food, water or soil. Load accumulates in the body. Lead causes damages to organs (kidneys, liver), brain and nerves. Exposure to high levels causes serious brain damage: mental retardation, behavioural disorder, memory problems and mood changes. Children exhibit vulnerability to the toxic effects of lead at much lower concentrations than adults. It has been shown that there is a strong link between high lead exposures and impaired intelligence. A limit value of 0.5 µg/m3 as annual mean has been set in the first daughter directive.
Traffic was an important source of lead in the atmosphere. Since the introduction of unleaded petrol concentrations have been decreased sharply. In 2006, 385[1] stations (of which 352 station have a data coverage of more than 14%, see below) reported lead concentration data to AIRBASE. The number of stations is relatively small compared to the other regulated pollutants. However, when concentrations are below the so-called lower assessment threshold monitoring is not longer mandatory and other objective estimating techniques (modelling) may be used for the assessment. For lead, the lower assessment threshold is 0.25 µg/m^3 ; this level has been exceeded at only 8 stations. The limit value has been exceeded at a few industrial hotspots in Bulgaria and Romania. It can be concluded that current lead concentrations are well below the limit value set for protection of human health.

The fourth Daughter Directive.

In the 4th Daughter Directive target values have been set for three metals (arsenic, cadmium and nickel) and for benzo(a)pyrene (B(a)P). The first year over which the MS have to report on the air quality assessment of these pollutants is 2008 (reporting date 30 September 2009). Networks for monitoring the 4DD-pollutants are operational since a number of years. The 2006-data received under the EoI has been extracted from AIRBASE and summarized here. An additional criterion on data coverage of 14% has been applied following the data quality objectives set in th e4th DD for indicative measurements. With the exception of B(a)P, concentrations are frequently below the lower assessment threshold which allows the use of other techniques (modelling or indicative measurements) to assess air quality. Although the data has been processed by the ETC/ACC according to the standard set of quality checks, a disclaimer has to be made. The 4DD defines that the pollutants has to be determined in the PM10 fraction according to EN 12341 and furthermore it describes the reference methods for chemical analysis. In reviewing the preliminary assessment reports prepared for the 4th DD it was concluded that there is no universal adoption of the reference methods (Barrett, 2007). The meta data available in AIRBASE is not sufficient to check compliance with the reference methods; this will hamper the comparability between countries.

Arsenic

For most people, food or drinking water is the major source of exposure. Exposure to inorganic arsenic can cause various health effects such as irritation of the stomach, decreased production of red and white blood cells, irritation of the skin and lung.
The main anthropogenic source of arsenic to the atmosphere is the burning of fossil fuels and waste incineration. Within the EU27 atmospheric emissions are expected to decrease with about 40% between 2000 and 2010 assuming current legislation. A small further decrease is estimated for 2020: almost 50% compared to 2000 (Hettelingh et al., 2006).
The reported 2006 concentration data suggests that attainment of the target value (annual mean of 6 ng/m3) might be a limited problem: at 2 of the 198 reporting stations an exceedance has been observed. These stations are located in Czech Republic and the Slovak

[1] Stations with only statistics included. The 247 stations In table 1 are excluding stations with only statistics.

Republic. A third station located in Bulgaria reports also an exceedance but this station did not fulfil the data coverage criterion of 14%. The emission projection indicates in these countries a larger reduction than averaged over the EU27. At the majority of the stations a concentration below the lower assessment threshold of 2.4 ng/m3 as annual mean is observed.

Cadmium

Environmental exposure to cadmium causes damages in particular in kidneys and bones. An increased risk of lung cancer has been reported following inhalation exposure at the working palce. Food is the main source of cadmium intake, for a non-smoker the uptake via inhalation is in the order of 10%.
The main source of cadmium in the atmosphere is the burning of fossil fuels and waste incineration. The emissions of cadmium in the EU27 are estimated to be 177 tonne in 2000. Under current legislation a decrease to 100 tonne in 2020 for the EU27 as a whole is expected (Hettelingh et al, 2006). Generally, the largest change in emissions occurs between 2000 and 2010; between 2010 and 2020 stable or slightly increasing emissions are expected unless additional measures are taken. The change in emissions between 2000 and 2020 varies strongly between the MS: from an increase of 25% (Cyprus) to a decrease of more than 70% in Estonia and Romania.
In the fourth Daughter directive a target value of 5 ng/m3 as annual mean has been set for cadmium to be met by 2012. In AIRBASE 260 stations are reporting cadmium concentrations, at 225stations data coverage is more than 14%. At about 4% of the stations, all located in Bulgaria and Romania, the target value has been exceeded. At 90% of the stations the concentrations are below the lower assessment threshold.

Nickel

In small quantities nickel is assumed to be essential for human nutrition. However, a too large uptake can be a danger for human health, e.g. an increase in the chance of development various forms of cancer (lung, nose, larynx, prostate), lung embolism, asthma and chronic bronchitis , heart disorders. An allergic reaction of the skin is a common effect from chronic skin contact with nickel (jewellery).
Releases from industrial combustion, power generation, waste incineration and the metallurgic industry form the most important anthropogenic sources. In 2000, the EU27 emission sare estimated as1966 tonne per year decreasing to 959 tonne (- 50%) in 2020 (Hettelingh et al., 2006).
A total of 211 stations reported annual mean dat to AIRBASE. One station in the United Kingdom reported an exceedance of the target value of 20 ng/m3; one station in Spain also reported an exceedance but the data coverage did not fulfil the 14% criterion. At more than 90% of the stations a concentration below the lower assessment threshold has been measured.

Benzo(a)pyrene

Benzo(a)pyrene or B(a)P is one of a group of compounds called polycyclic aromatic hydrocarbons (PAH). PAH are not commercially produced nor used; they enter the environment as a result of incomplete combustion. Main sources are wood and waste burning, and mobile sources. B(a)P is carcinogenic and long-term exposure may have developmental and reproductive effects. The 4th DD sets the target value for B(a)P at 1 ng/m3 as annual mean.
In AIRBASE 86 station s (77 with a data coverage of more than 14%) reported data. At a large fraction of these stations (n=33) the annual mean exceeds the target value. The stations reporting an exceedance are located in Austria, the Czech Republic and Bulgaria. Exceedances are observed both in the (sub)urban background as well as on hot-spots (traffic, industrial) locations.

3. CONCLUSIONS

The EoI2007 data cycle was very successful. A total of 35 countries, including the 27 EU Member States, have provided air quality data for 2006. Measurement data from 3987 stations have been delivered, 135 stations more than in the EoI2006. The spatial station coverage of $PM_{2.5}$ has been increased but is still insufficient. $PM_{2.5}$ measurement data have been reported from only 320 stations.
The exchange of information should cover at least the stations which are included in the FWD/Questionnaire (EU 2004b). However not all stations listed in the delivered questionnaires have been reported under the EoI. 700 questionnaire stations cannot be found in AIRBASE. For the next EoI2009 ETC/ACC will send a list of questionnaire stations which are not in AIRBASE to the EoI data suppliers with the request to deliver both meta data and measurement data for these stations.
In spite of the request in the EoI2006 letter to send at least two of the three NO components (NO_2, NO, NO_x), there is also still a difference of 775 stations 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. This is surprising as most automated monitors measure both pollutants simultaneously.
13 countries have reported one or more VOCs except Benzene (ozone precursors 3DD). An increasing number of countries has complied with the request to send 4DD pollutants: 13 countries have reported Heavy Metals except Lead and 8 countries have reported PAHs.
Nearly all countries have delivered the data in time before 1st of October 2007. ETC/ACC has produced QA/QC country feedback reports. The response on these reports was very good. The quality of the meta information, measurement data but also the derived information (statistics, exceedances) in AIRBASE has been improved considerably.
Concerning the air quality state for the selected pollutants we can conclude the following. Pollution by SO2 shows a decreasing trend both in emissions as well as in ambient concentrations. Exceedances of the health related limit values are observed at a limited number of stations only. The emission of NOx decreases but concentrations in urban and traffic areas are decreasing at a much lower rate. Compliance with the NO_2 limit value for annual mean values is a serious problem in many urban and traffic areas. During the last five years emissions of primary PM10 and its precursor gasses are reducing slowly but in the observed concentrations no clear European-wide trend is seen. The PM_{10}-limit value for daily values is exceeded frequently at urban background and traffic stations. The ambient levels of CO are below the limit value; some incidental exceedances are observed but in these cases measuring artifacts can not be excluded. The benzene concentrations are in compliance with the limit values except for a limited number of traffic hotspot situations. Ozone precursor emissions are decreasing; the ozone concentrations, however, do not show a decreasing trend. On the contrary, the health related and the annual mean values show an increasing tendency. Both the health and the ecosystem related target values are exceeded frequently and widely over Europe. The lead concentrations are well below the limit value for protection of human health. Several Member States have reported heavy metals (arsenic, cadmium, nickel) and benzo(a)pyrene regulated under the fourth Daughter Directive. The air pollution by these heavy metals is generally low: the concentrations are below the lower assessment threshold, for arsenic at the majority of the stations, and for cadmium and nickel at more than 90% of the stations. The benzo(a)pyrene annual mean concentrations however exceed the target value at about 40% of the 86 reported stations.

4. GLOSSARY

EoI	Exchange of Information
EMEP	Co-operative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe
FWD	Air Quality Framework Directive on ambient air quality assessment and Management
DD	Daughter Directives
NRT	Near Real Time
EU	Europian Union
EEA	European Environment Agency
ETC/ACC	European Topical Centre on Air and Climate Change
DG ENV	Directorate-General Environment
DEM	Data Exchange Module
NUTS	Nomenclature des Unités Territoriales Statistiques
LAU	Local Administrative Units
SABE	Seamless Administrative Boundaries of Europe
EBM	EuroBoundaryMap
GIS	Geographical Information System
AQ	Air Quality
ETRS89	European Terrestrial Reference System 1989
ETC/LUSI	European Topic Centre Land Use and Spatial Information
AOT40	ozone concentrations Accumulated dose Over a Threshold of 40 ppb
LV	Limit value
TV	Target value

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Annex A Exchange of Information requirements

The Member States of the European Union 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 Exchange of Information (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 Exchange of Information (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 Exchange of Information (EU, 2001a).

Table A.3 Overview of mandatory pollutants to be delivered under the Exchange of Information (EoI)

EoI nr.	Formula	Name of pollutant	Units of measurement	Average over
1	SO_2	Sulphur dioxide	µg/m³	1 h
2	NO_2	Nitrogen dioxide	µg/m³	1 h
3	PM_{10}	Particulate matter < 10 µm	µg/m³	24 h
4	$PM_{2.5}$	Particulate matter < 2.5 µm	µg/m³	24 h
5	SPM	Total suspended particulates	µg/m³	24 h
6	Pb	Lead	µg/m³	24 h
7	O_3	Ozone	µg/m³	1 h
8	C_6H_6	Benzene	µg/m³	24 h
9	CO	Carbon monoxide	mg/m³	1 h
10	Cd	Cadmium	ng/m³	24 h
11	As	Arsenic	ng/m³	24 h
12	Ni	Nickel	ng/m³	24 h
13	Hg	Mercury	ng/m³	24 h
14	BS	Black smoke	µg/m³	24 h
15	NO_X	Nitrogen oxides	µg NO_2/m³	1 h

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

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

Statistics in AIRBASE are based on *Daily values*, *Hourly values* or *Daily 8-hour maxima*. Before the statistics are calculated, the hourly (if available) are aggregated. In aggregation of hourly data to longer averaging periods (8 hourly, daily) a 75% availability of raw data is required to calculate a valid aggregated value. That is, starting with hourly concentrations:

- a daily averaged concentration is calculated when at least 13 valid hourly values are available with not more than 6 successive hourly values missing;
- a 8-hourly averaged concentration is calculated when at least 6 valid hourly values are available;
- maximum daily 8-hour mean is calculated when at least 18 valid running 8-hour averages per day are available.

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

- *General* concentration statistic: annual mean, 50, 95, 98, 99.9 percentiles, maximum and y^{th} highest value
- *Exceedances*: hours/days with concentration > y µg/m3 (with y = limit or threshold value)
- *AOT40*: ozone concentrations Accumulated dose Over a Threshold of 40 ppb [1]

Annual statistical parameters as given in the next table are routinely calculated and stored in AIRBASE. The statistical parameters are calculated irrespective of the proportion of valid data (data capture). Criteria on data capture are given both in the EoI decision and in the respective daughter directives. These criteria refer to the use of the monitoring data for checking compliance with air quality limit or target values. The objective of the EoI is not and should not be to replace official reporting and identification of exceedances of air quality limit values. This remains the responsibility of the Member States. For other objectives, these criteria might be too stringent. Therefore, no rejection criteria have been applied.

[1] AOT40 value is calculated from hourly values between 8.00 and 20.00 CET from 1 May to 31 July according to the definition in the ozone directive (EU, 2002). In all reports an estimated value corrected for missing values will be presented.

Component	Parameter based on		
	1 hour values	daily values	Daily 8h maxima
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	• annual mean • 50 percentile • 95 percentile • 98 percentile • maximum • days with c >120 µg/m^3, • 26th highest value
Carbon monoxide (CO)	• annual mean	• annual mean	• annual mean • 50 percentile • 95 percentile • 98 percentile • maximum
Particulate matter (PM_{10})	• annual mean	• 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

Annex C. QA/QC feedback actions

Overview of the QA/QC activities undertaken by the data suppliers and ETC/ACC during the EoI2007 reporting cycle is given in *Table B1*; some additional QA/QC feedback actions are described in *Table B2*. The QA/QC checks are described "QA/QC checks on air quality data in AIRBASE and on the EoI2004 data – Procedures and results" (see Mol *et al.* 2005b).

Table B1. QA/QC actions on EoI2007 data in 2007 and 2008		
Date	**Processes by data supplier**	**Processes by ETC/ACC**
1 June 2007		Release of the DEMv9
	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 to Central Data Repository (CDR)	Help desk
1 Oct 2007 to 15 Jan 2008		Upload DEM into AIRBASE Checks on outliers, missing essential meta data, resubmission old data, deletion stations/measurement configurations with data. Send feedback reports to the data suppliers
	Replies on the feedback reports add response rate(s)	
		Processing of the (non) replies
15 Jan 2008		Calculation of statistics and exceedances
7 March 2008		Release of AIRBASE with EoI2007 data (see airbase history page)

Table B2. QA/QC follow up on data supplied in earlier EoI cycles in 2008		
Date	**Processes by data supplier**	**Processes by ETC/ACC**
20 March 2008		Feedback reports on negative outliers before 2002
	Replies on feedback reports	
15 April 2008		Processing of the (non) replies

35 countries have delivered EoI2006 data (see the status table in Annex D).
The response on the feedback reports was very good.

Results of the feedback actions are available at Circa EIONET Air and Climate Change interest group:

http://eea.eionet.europa.eu/Members/irc/eionet-circle/airclimate/library?l=/qaqc_country_feedback/eoi_2007_2006_data&vm=detailed&sb=Title

This information is not public. For access to this information a CIRCA user account and password is needed.

Table B3. Status overview of QA/QC feedback actions on the EoI-2007 reporting cycle

Status	Country feedback						
Country		outliers (extreme/ suspicious)	missing data	missing essential meta inform.	resub mitted data	deletion stations/ meas.conf. with data	reply received
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						

Outliers (green, yellow, red). For definition see Mol *et all* , 2005b.

green outliers: outside ETC/ACC outlier limit values, but seems to be ok.

yellow outliers: outside ETC/ACC outlier limit values, but looks suspicious

red outliers: outside ETC/ACC outlier limit values, but looks extreme

(red)	unknown status outliers (outliers reported, but no reply; green outliers are demarked in AirBase, so they are supposed to be correct; the yellow and red outliers remain marked in AirBase as incorrect, so they are not visible in AirBase
(hatched green)	one or more real outliers detected; reply from MS; corrected data are delivered or the data are marked in AirBase (not visible in AirBase)
(light green)	The detected data are no outliers. The data remain unchanged in AirBase.

Missing data

(red)	detected in feedback report, no reply received
(hatched green)	data/meta data submitted
(light green)	missing data explained

Missing essential meta information

(red)	detected in feedback report, no reply received
(hatched green)	missing information explained and (partly) submitted
(light green)	missing information explained

Resubmitted data

(red)	detected in feedback report, no reply received. The resubmitted data remain unchanged in AirBase
(hatched green)	The resubmission has been removed and the old overwritten data has been restored in AirBase
(light green)	Confirmation that the resubmission was intended, so the resubmitted data remain unchanged in AirBase

Deletetion of stations or measurement configurations with data

(red)	detected in feedback report, no reply received; the meta information has been kept in AirBase
(hatched green)	The MS wants to keep this meta information in AirBase
(light green)	Confirmation to delete. The stations or measurement configurations have been removed from AirBase

Reply received on the country feedback report

(red)	expected reply NOT received
(hatched green)	expected reply received: report-modifications
(light green)	no reply received: no report-modifications

Annex D Status overview of the EoI 2007 EoI Reporting

ETC/ACC provides a regularly updated progress report for the annual EoI data cycle on:
http://air-climate.eionet.europa.eu/country_tools/aq/eoi_to_airbase_status/index_html

Overview 2007 EoI Reporting (Air Quality data of 2006)

Status since: 16-4-2008

Country (#)		Date EoI data arrived at ETC/ACC	Initial upload to AirBase for QA/QC checking	Date QA/QC report sent to country	Date country reply to QA/QC report	End date processing data and statistics into AirBase	Remark
Alpha-2	Short name					(***)	
AL	Albania						
AT	Austria *	28-08-07	08-10-07	15-11-07	06-12-07	13-02-08	
BA	Bosnia-Herzegovina	26-09-07	10-10-07	08-11-07	11-12-07	13-02-08	
BE	Belgium *	29-11-07	03-12-07	06-12-07	11-01-08	13-02-08	
BG	Bulgaria *	25-09-07	10-10-07	12-11-07	21-11-07	13-02-08	
CH	Switzerland **	28-09-07	22-10-07	08-11-07	15-11-07	13-02-08	
CY	Cyprus *	28-09-07	23-10-07	08-11-07	10-01-08	13-02-08	
CZ	Czech Republic *	27-09-07	10-10-07	12-11-07	06-12-07	13-02-08	
DE	Germany *	26-09-07	26-11-07	27-11-07	18-12-07	13-02-08	
DK	Denmark *	28-09-07	23-10-07	12-11-07	12-11-07	13-02-08	
EE	Estonia *	28-09-07	23-10-07	08-11-07	08-11-07	13-02-08	
ES	Spain *	05-10-07	24-10-07	12-11-07	30-11-07	13-02-08	
FI	Finland *	29-11-07	03-12-07	06-12-07	10-12-07	13-02-08	
FR	France *	30-09-07	20-11-07	21-11-07		13-02-08	
GB	United Kingdom *	28-09-07	23-10-07	15-11-07	21-12-07	13-02-08	
GR	Greece *	28-09-07	23-10-07	08-11-07	13-12-07	13-02-08	
HR	Croatia	23-08-07	08-10-07	08-11-07	28-01-08	13-02-08	
HU	Hungary *	28-09-07	22-10-07	12-11-07	21-11-07	13-02-08	
IE	Ireland *	28-08-07	10-10-07	12-11-07	12-12-07	13-02-08	
IS	Iceland **	12-10-07	24-10-07	08-11-07		13-02-08	no reply expected
IT	Italy *	26-10-07	05-12-07	07-12-07		13-02-08	11/01/08: 2nd feedback sent
LI	Liechtenstein **	24-09-07	10-10-07	08-11-07		13-02-08	no reply expected
LT	Lithuania *	24-09-07	10-10-07	08-11-07	11-01-08	13-02-08	
LU	Luxembourg *	21-03-08	21-03-08	27-03-08		27-03-08	
LV	Latvia *	21-09-07	10-10-07	08-11-07	20-11-07	13-02-08	
ME	Montenegro						
MK	FYR of Macedonia	27-09-07	11-10-07	12-11-07	15-01-08	13-02-08	
MT	Malta *	19-12-07	19-12-07	19-12-07	09-01-08	13-02-08	
NL	Netherlands *	30-09-07	23-10-07	15-11-07		13-02-08	
NO	Norway **	27-09-07	11-10-07	08-11-07	14-11-07	13-02-08	
PL	Poland *	28-09-07	23-10-07	13-11-07	14-12-07	13-02-08	
PT	Portugal *	27-09-07	11-10-07	12-11-07	11-12-07	13-02-08	
RO	Romania *	28-09-07	23-10-07	12-11-07	06-12-07	13-02-08	
RS	Serbia	28-09-07	23-10-07	21-11-07	04-12-07	13-02-08	
SE	Sweden *	27-09-07	11-10-07	08-11-07	15-11-07	13-02-08	
SI	Slovenia *	28-09-07	23-10-07	15-11-07	24-01-08	13-02-08	
SK	Slovak Republic *	27-09-07	11-10-07	12-11-07	15-11-07	13-02-08	
TR	Turkey **						

*	EU-27 country
**	Non EU-27 country, EEA-32 country
(***)	Data not yet available via website (AirView)
(#)	ISO3166-1 codes: Alpha-2 element and Short Name