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Development of sensor-based Citizens' Observatory Community for improving quality of life in cities

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Metadata on existing data sources for air quality and environmental conditions in Europe

Work Package 6

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Executive Summary

Metadata about existing European air quality monitoring networks and similar data sources have been compiled and are presented here as a preparation for data assimilation tasks planned to be carried out later in WP6 of CITI-SENSE. The rationale behind dataset selection is explained and an overview of the various selected datasets is given. The primary focus for the detailed description is on two main air quality monitoring networks in Europe, namely the AirBase database operated by the European Environmental Agency, and the European Monitoring and Evaluation Programme network of air quality stations. Additional metadata are provided for other datasets, in particular those provided by related EU projects. Detailed information about the various datasets is given in a comprehensive appendix.

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1 Introduction

The primary objective of CITI-SENSE work package 6 (WP6) is to provide environmental data products on air pollution and meteorological conditions to the various stakeholders, namely a) citizens, b) citizen's groups, c) policy makers, and d) the Global Monitoring for Environment and Security Initiative (GMES).

Several of the primary tasks of WP6 are concerned with the use of data assimilation and data fusion concepts for providing the foundation for an error analysis of environmental data products on air pollution, meteorology, and environmental conditions. The first task of WP6 is, therefore, a preparatory activity that involves the compilation of metadata about various established air quality observation networks and similar datasets. This information will subsequently guide selection of suitable datasets to be used within the data assimilation procedure. As part of the data assimilation procedure, an error assessment will be provided of the data assimilation products, as well as of the input observations and models.
Following the official task description in the CITI-SENSE Description of Work (DOW), the primary objective of this document is to report on a comprehensive compilation of metadata related to European air quality monitoring networks. It was carried out to support planned data assimilation tasks within WP6. Two datasets providing data from air quality monitoring stations were chosen for further investigation as the potentially most suitable datasets for this task, and are described here in detail: The AirBase database operated by the European Environmental Agency, and the data provided by the European Monitoring and Evaluation Programme, available through the EBAS database. Some additional data sources providing further information, such as other EU projects and local air quality models are given as well. This list of data sources is not intended to be exhaustive.

2 Selection criteria and dataset overview

The case studies or Empowerment Initiatives (EIs) which will be carried as part of WP2 will make use of sets of static and portable microsensors collecting environmental data, primarily on air quality in city areas. The data collected from such sensors are planned to be used in WP6 in combination with existing data sources using data assimilation techniques such as the Kalman Filter and others, in order to provide a value-added product to citizens.

2.1 Data to be measured by CITI-SENSE

Data will be measured within CITI-SENSE at a total of eight locations. These locations are the cities of Barcelona, Belgrade, Edinburgh, Haifa, Ljubljana, Oslo, Ostrava, and Vienna. Detailed information about the environmental conditions at each of these locations can be found in CITI-SENSE deliverable D2.1 (CREAL, 2013).

The majority of the locations will deploy low-cost, wireless, mobile sensors that provide observations of the concentrations of various air pollutants (CO, NO_x, O_3, particulate matter - PM), various meteorological parameters (temperature, relative humidity, atmospheric pressure, UV radiation), and other environmental conditions such as location and acceleration.

More specifically, the static outdoor sensor nodes will measure CO, NO_2, NO_x, O_3, PM, humidity, temperature, and noise. The mobile personal sensors will measure CO, NO_2, O_3, GPS (Global Positioning System) coordinates, and accelerometry. In addition, the locations of Oslo and Belgrade have expressed the intent to also use mobile sensor nodes to be installed on vehicles. These will measure CO, CO_2, NO_2, NO_x, O_3, PM, humidity, temperature, and noise.

In addition to these standard measurements provided by the CITI-SENSE sensor platforms, some of the locations will be using slightly different methods and will also measure other parameters. Belgrade intends to also measure polycyclic aromatic hydrocarbons (c-PAH(s)). Ostrava plans to measure $PM_{2.5}$, SO_2, NO_2, VOCs as well as c-PAHs and human carcinogen benzo[a]pyrene (B[a]P).

2.2 Dataset choice

The datasets investigated here in more detail were selected based upon their potential for being used within the framework of the data assimilation work that is planned to be carried out in several of the tasks in WP6. As such, datasets are selected accounting for the *high spatio-temporal resolution required to address the objectives of WP6, namely the timescales and spatial scales that are associated with the daily activities of individual citizens* (as described by the CITI-SENSE DOW).
A particular focus is the collection of air quality data, as CITI-SENSE case studies related to air quality have been identified as the most suitable example for demonstrating the usefulness of data assimilation techniques with respect to data collected by citizens.

The main criteria used for dataset selection for in-depth analysis were:

- Spatial extent: The dataset ideally must cover all of Europe to be applicable for the case studies in all cities deploying sensors;

- Spatial scale: The spatial scale of the dataset must to first order be comparable to the data collected by the deployed microsensors in the participating cities;
- Temporal scale: The temporal scale of the dataset must to first order be comparable to the data collected by the deployed microsensors in the participating cities;
- Relevant observations: The datasets must include parameters relevant to those measured by the CITI-SENSE microsensors;
- Data availability: Data should be available at the time of deployment of the CITI-SENSE microsensors.

The most limiting factors for dataset selection are resolution in space and time. As for the latter, the static and portable sensors to be deployed within the framework of WP2 of the CITI-SENSE project have sampling frequencies on the order of seconds to minutes, in contrast to officially reported observations from AQ stations, which are generally given using hourly temporal sampling.

In WP6 several spatio-temporal resolutions of the data products will be considered; these will be achieved by averaging the CITI-SENSE data in space (e.g. from street level to neighbourhood and city) and time (e.g. from minutes to hours, days, weeks, months and years). Note that at the spatio-temporal resolution of the citizen (minutes and metres), satellite data commonly used in data assimilation for meteorology and air quality purposes will not be appropriate, owing to their very large footprint in space and time.

2.3 Dataset overview

Based on the criteria listed in the previous section, two datasets have been chosen for in-depth analysis. These are the air quality database operated by the EEA, AirBase, and the EMEP monitoring network. Note that other datasets (e.g. concerning air quality, meteorology, pollen) may be available and may be considered by WP6. Examples are discussed later in this report.

Table 1 provides an overview of the most critical metadata parameters for the two selected datasets

Table 1: Overview of metadata for the two main air quality monitoring networks in Europe

CATEGORY		EEA	EMEP
DATA	Total number of stations	7965	321
	NOx	Yes	Yes
	SO2	Yes	Yes
	PM10	Yes	Yes
	PM2.5	Yes	Yes
	CO	Yes	Yes
	Pollen	No	No
	Primary station type	All (traffic, background)	Mostly background

SPATIAL	Domain	Europe and some European territories worldwide	Europe
	Spatial Extent		
	Southern Limit [Lat]	-22.30	35.04
	Northern Limit [Lat]	78.90	78.91
	Western Limit [Lon]	-61.59	-51.65
	Eastern Limit [Lon]	166.47	70.28
TEMPORAL	Temporal sampling	hourly	various (often daily)
	Earliest data [Yr]	1950	Not known
	Latest data [Yr]	present	present
ACCESS	URL	http://www.eea.europa.eu/data-and-maps/data/airbase-the-european-air-quality-database-7	http://ebas.nilu.no/Default.aspx
	Cost	Free	Free
	Data format	CSV	NASA Ames

3 Data provided through the European Environmental Agency

3.1 Overview

The European Environmental Agency (EEA) provides air quality data primarily through its *European Air quality dataBase*, AirBase (http://acm.eionet.europa.eu/databases/airbase/). AirBase is a public database system operated by the EEA and provides air quality monitoring data and associated information submitted by all participant countries within Europe. The latest quality-controlled version of AirBase at the time of writing is version 6. An interim product of version 7 was available but not considered here owing to its preliminary nature. Version 6 of AirBase provides air quality data from 39 countries throughout Europe. The raw data are provided in ASCII format and all metadata used for compiling this report are available at http://www.eea.europa.eu/data-and-maps/data/airbase-the-european-air-quality-database-6.

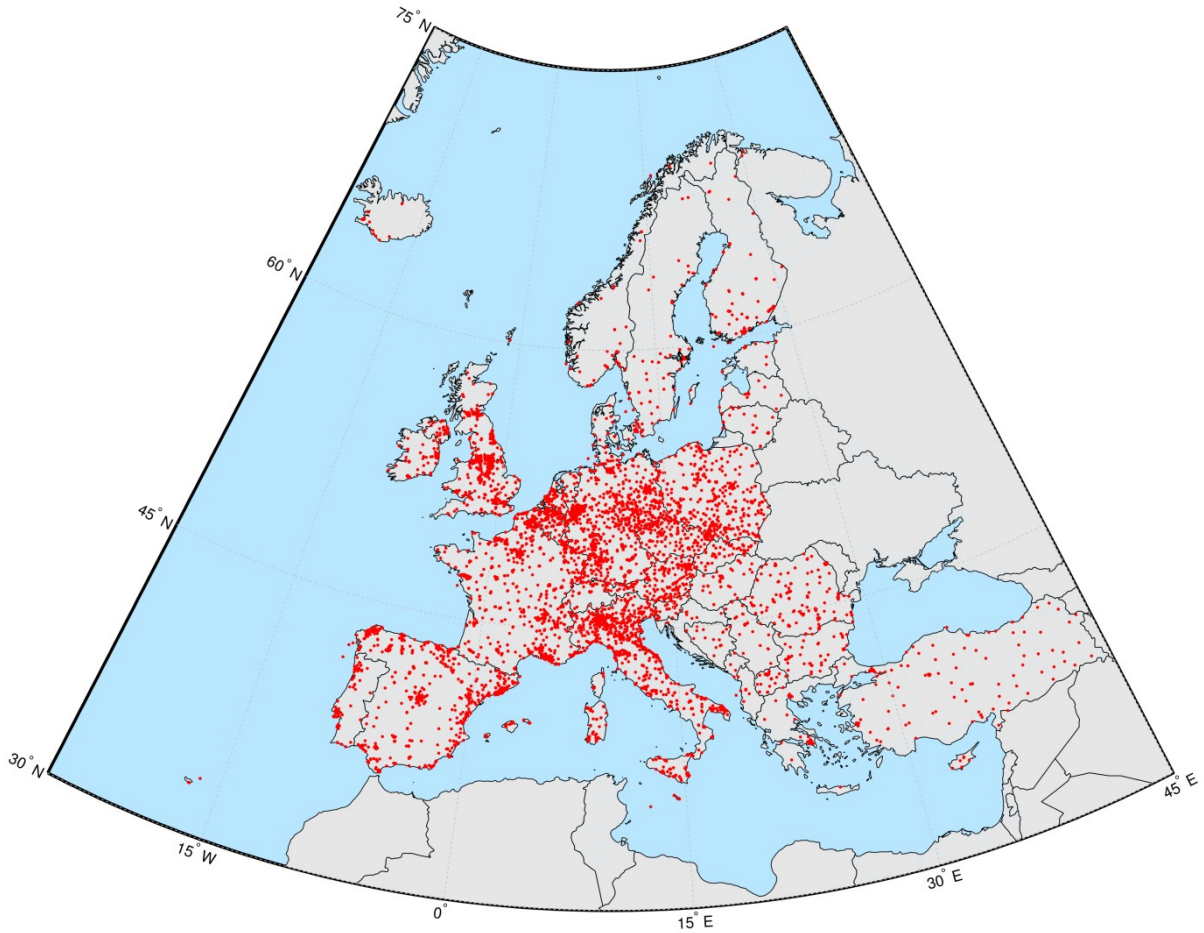

Figure 1: Overview of the locations of all European air quality stations that provide data in AirBase. There are a few stations located in territories outside Europe which are not shown here. Note not all stations shown here are currently operational.

3.2 Available Data

At the time of writing, the most recent version of AirBase is version 6. It provides data for a total number of 7965 stations, of which 4280 are classified as urban stations, 2208 as suburban stations, and 1339 as rural stations. 138 stations are unclassified in the metadata. Figure 1 shows a map of the locations of all European air quality stations that deliver data within the AirBase database (or have done so in the past). The highest density of air quality stations can be found in Germany, the Netherlands, Belgium, and Northern Italy. Comparatively sparse coverage can be found in the Nordic countries.

Airbase provides data from background, traffic, and industrial stations. The area around the stations is further classified into urban, suburban, and rural types. Table 2 lists the number of all Airbase stations by country. Note not all stations listed are currently operational.

The primary components provided by AirBase are sulphur dioxide (SO_2), particulate matter less than 10 µm in diameter (PM10), ozone (O_3), nitrogen dioxide (NO_2), nitrogen oxides (NO_x), carbon monoxide (CO), and nitrogen monoxide (NO). A complete list of components measured throughout all AirBase stations in Europe can be found in Table 11 in the Appendix.

Fifty-five (55) of the stations providing data within Airbase also deliver data to the EMEP monitoring network.

Table 2: Number of stations within Airbase by country. Note not all of these stations are currently operational. For specific stations that are currently operational within the areas of the eight CITI-SENSE study sites and further data on what relevant species are measured at these stations, see section 3.3.

Country	Total number of stations
Albania	8
Andorra	3
Austria	263
Belgium	382
Bosnia - Herzegovina	22
Bulgaria	42
Croatia (Local Name: Hrvatska)	8
Cyprus	9
Czech Republic	199
Denmark	42
Estonia	11
Finland	102
France	1100
Germany	1381
Greece	37
Hungary	49
Iceland	18
Ireland	106

Italy	1168
Latvia	20
Liechtenstein	2
Lithuania	25
Luxembourg	14
Macedonia; Former Yugoslav Rep.	46
Malta	8
Montenegro	4
Netherlands	124
Norway	62
Poland	526
Portugal	106
Romania	179
Serbia	29
Slovakia (Slovak Republic)	61
Slovenia	34
Spain	839
Sweden	84
Switzerland	49
Turkey	117
United Kingdom	686

3.3 Airbase data in the 8 pilot cities

In order to show more specifically how Airbase data can be used within the CITI-SENSE empowerment initiatives, the following sections present the Airbase data that are most relevant for the eight CITI-SENSE pilot cities. For each city, a map showing the relevant AQ stations that are indicated in the database to be currently operational, is shown. The stations are further organised by station type. In addition, for each city a table is presented showing the Airbase stations in the area and presenting some basic metadata for each station. Most importantly, the tables show for each station which CITI-SENSE-relevant AQ parameters are observed.

3.3.1 Barcelona

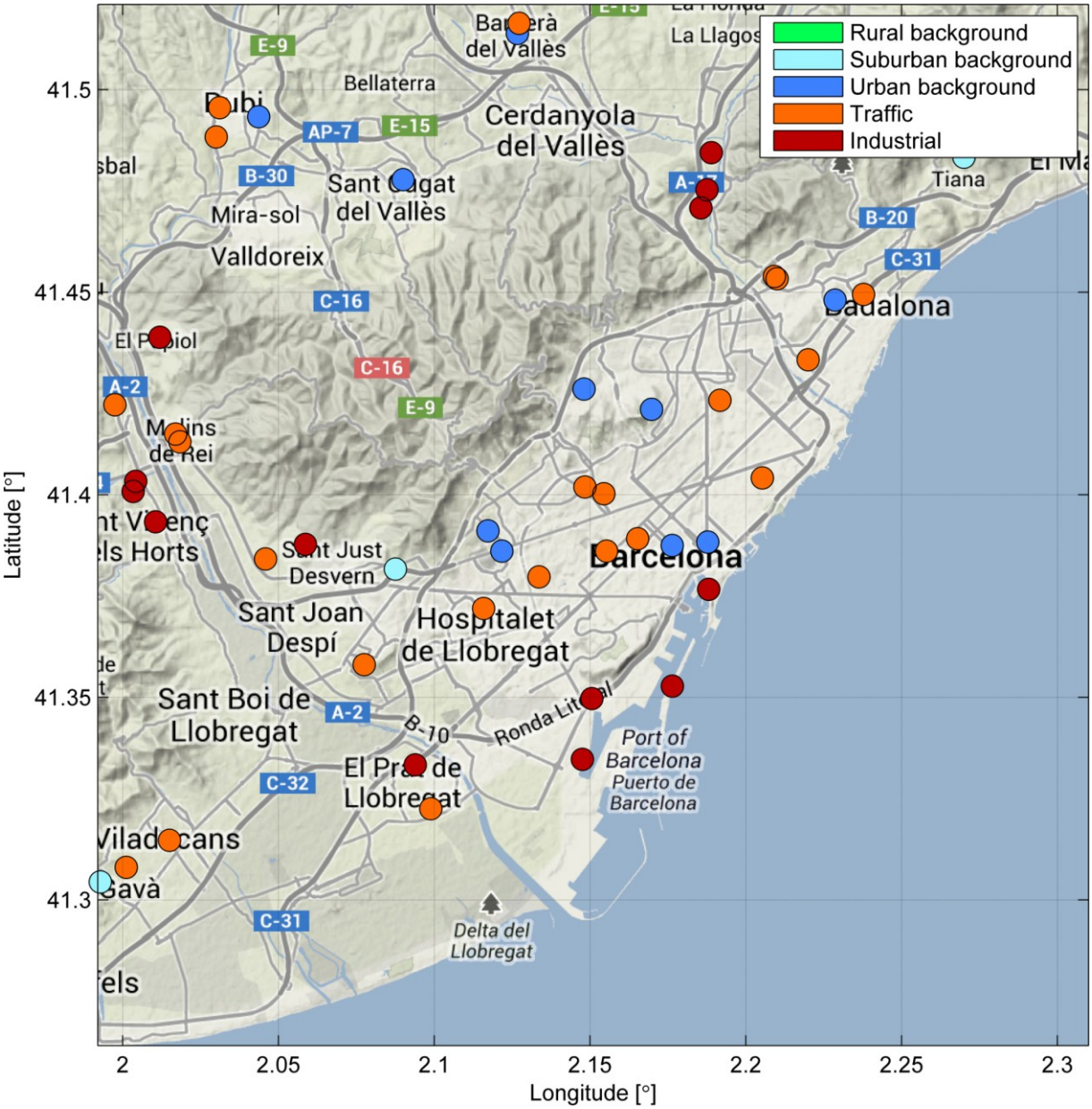

Figure 2: Map of Airbase stations located throughout the Barcelona study site. Only stations indicated as currently operational in the database are shown.

Table 3: Airbase stations relevant for the Barcelona study site and some basic metadata.

Station Code	Station Area	Station Type	Relevant Species measured
ES0266A	suburban	Background	PM10
ES1788A	suburban	Background	NO2, NOX, O3, SO2
ES1842A	suburban	Background	PM10
ES0567A	urban	Background	PM10
ES1231A	urban	Background	CO, NO2, NOX, O3, PM10, SO2

ES1551A	urban	Background	CO, NO2, NOX, SO2
ES1679A	urban	Background	CO, NO2, NOX, O3, SO2
ES1684A	urban	Background	CO, NO2, NOX, O3, PM10, PM2.5, SO2
ES1852A	urban	Background	PM10, PM2.5
ES1856A	urban	Background	CO, NO2, NOX, O3, PM10, PM2.5, SO2
ES1900A	urban	Background	PM10
ES1904A	urban	Background	not given
ES1928A	urban	Background	PM10
ES0559A	urban	Traffic	PM10, PM2.5, SO2
ES0586A	urban	Traffic	PM10, SO2
ES0596A	urban	Traffic	CO, NO2, NOX, O3, SO2
ES0691A	urban	Traffic	CO, NO2, NOX, O3, PM10, PM2.5, SO2
ES0692A	urban	Traffic	CO, NO2, NOX, O3, PM10, SO2
ES0695A	urban	Traffic	NO2, NOX, SO2
ES0700A	urban	Traffic	PM10
ES1148A	suburban	Traffic	CO, NO2, NOX, O3, PM10, SO2
ES1195A	urban	Traffic	CO, NO2, NOX, O3, PM10, SO2
ES1263A	suburban	Traffic	CO, NO2, NOX, PM10, SO2
ES1360A	suburban	Traffic	PM10, SO2
ES1362A	urban	Traffic	PM10, SO2
ES1396A	urban	Traffic	CO, NO2, NOX, PM10, SO2
ES1438A	urban	Traffic	CO, NO2, NOX, O3, PM10, SO2
ES1453A	urban	Traffic	CO, NO2, NOX, O3, PM2.5, SO2
ES1480A	urban	Traffic	CO, NO2, NOX, O3, PM10, PM2.5, SO2
ES1682A	suburban	Traffic	O3
ES1683A	suburban	Traffic	PM10
ES1776A	urban	Traffic	PM10
ES1892A	urban	Traffic	CO, NO2, NOX, O3, SO2
ES1895A	suburban	Traffic	PM10
ES1903A	suburban	Traffic	NO2, NOX, PM10, PM2.5
ES1929A	suburban	Traffic	NO2, NOX, O3, PM10, SO2
ES0584A	suburban	Industrial	CO, NO2, NOX, O3, PM10, SO2
ES0694A	suburban	Industrial	NO2, NOX, O3, PM10, SO2
ES0801A	urban	Industrial	NO2, NOX, PM10, SO2
ES1512A	urban	Industrial	PM10
ES1513A	urban	Industrial	PM10
ES1552A	suburban	Industrial	PM10
ES1587A	suburban	Industrial	O3
ES1663A	suburban	Industrial	PM10, PM2.5
ES1665A	suburban	Industrial	PM10
ES1870A	suburban	Industrial	PM10

ES1871A	suburban	Industrial	PM10
ES1931A	suburban	Industrial	PM10
ES1964A	suburban	Industrial	PM2.5

3.3.2 Belgrade

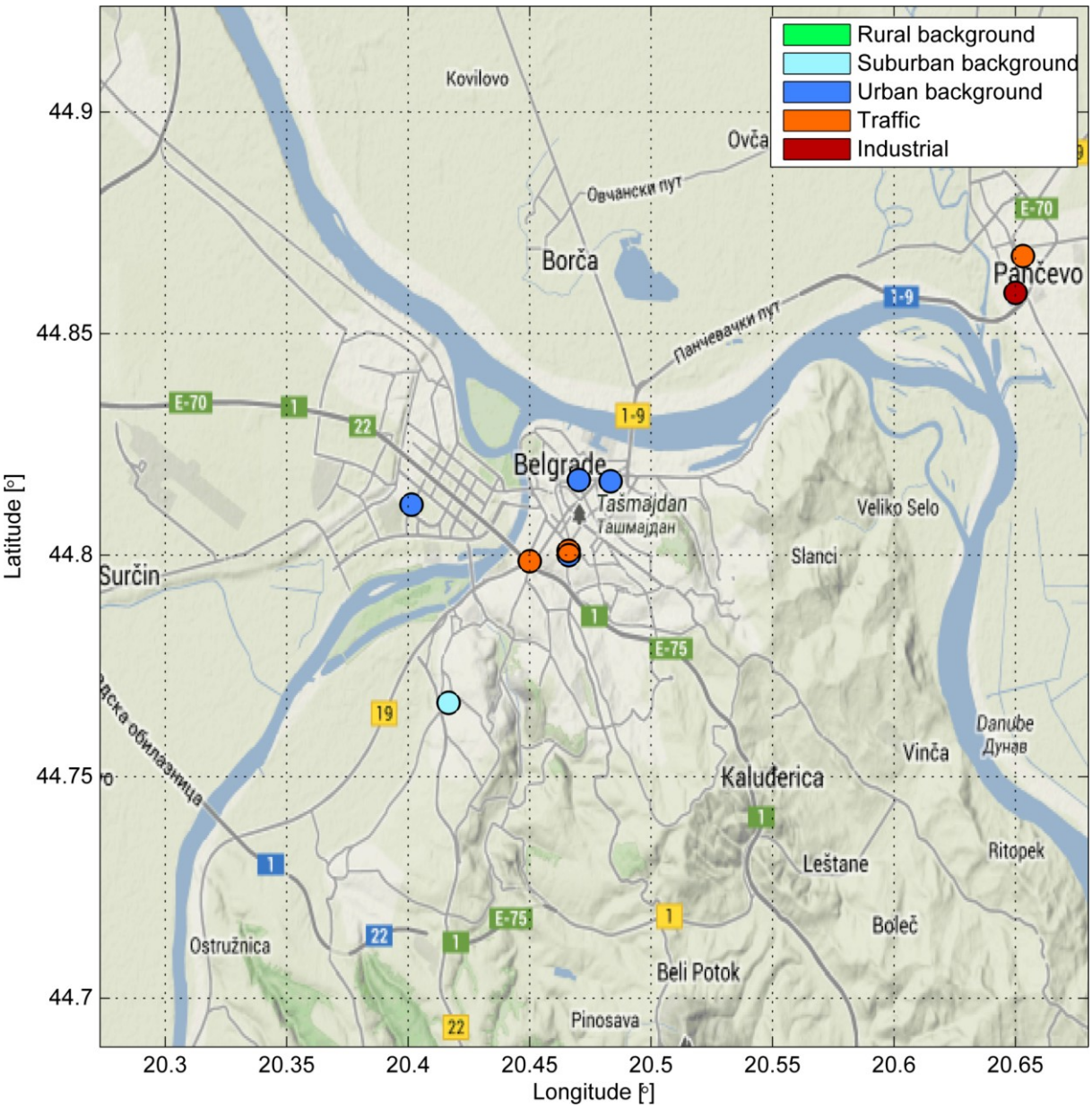

Figure 3: Map of Airbase stations located throughout the Belgrade study site. Only stations indicated as currently operational in the database are shown.

Table 4: Airbase stations relevant for the Belgrade study site and some basic metadata.

Station Code	Station Area	Station Type	Relevant Species measured
RS0003A	suburban	Background	NO2, SO2
RS0005A	suburban	Background	NO2, SO2
RS0004A	suburban	Background	NO2, SO2
RS0008A	urban	Background	CO, NO2, NOX, PM10, SO2
RS0007A	urban	Background	NO2, NOX, O3, SO2
RS0028A	urban	Background	CO, NO2, NOX, O3, PM10, SO2
RS0021A	urban	Background	NO2, SO2
RS0027A	urban	Background	NO2, SO2
RS0022A	urban	Background	NO2, SO2

3.3.3 Edinburgh

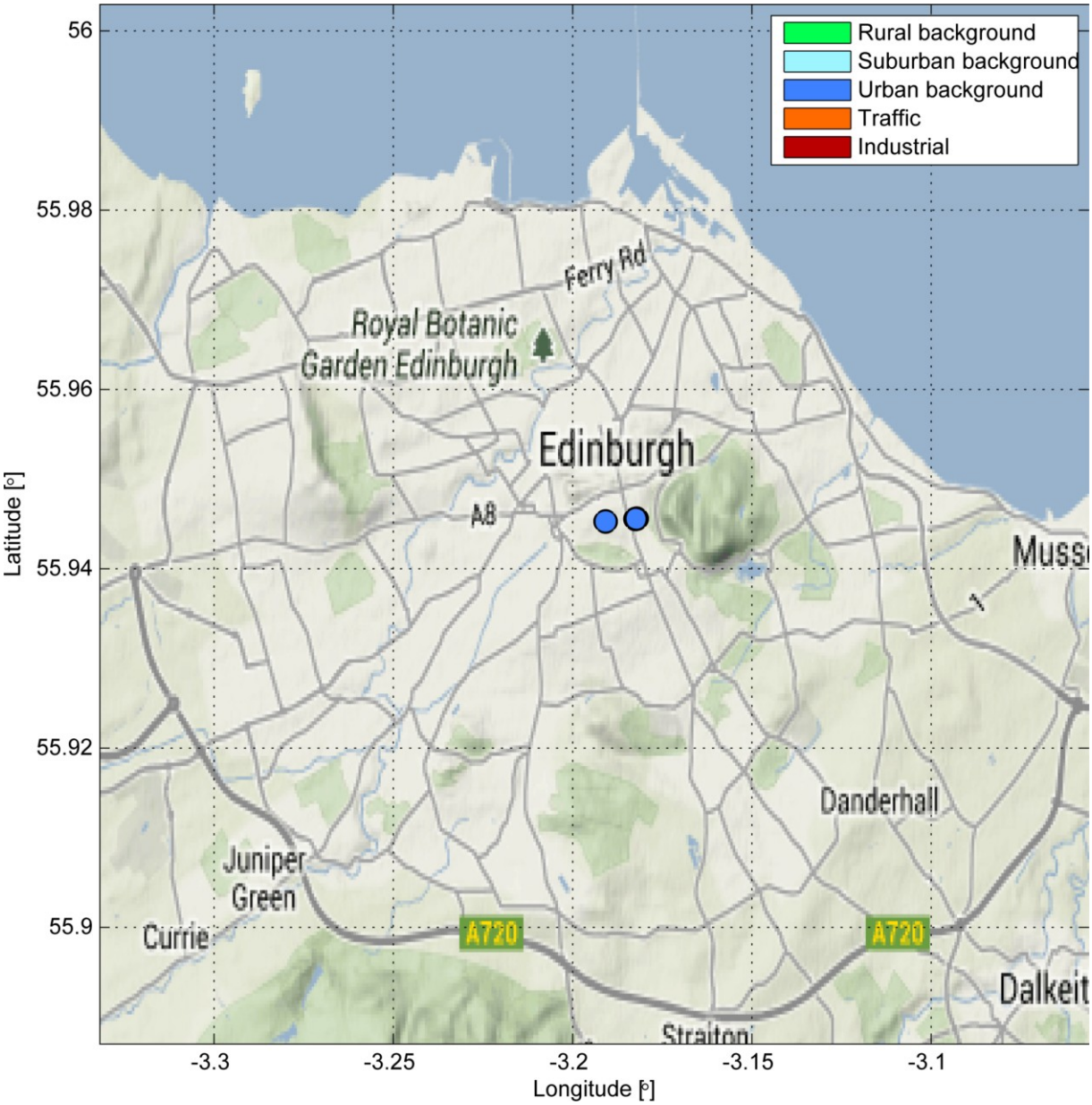

Figure 4: Map of Airbase stations located throughout the Edinburgh study site. Only stations indicated as currently operational in the database are shown.

Table 5: Airbase stations relevant for the Edinburgh study site and some basic metadata.

Station Code	Station Area	Station Type	Relevant Species measured
GB0665A	suburban	Background	not given
GB0839A	suburban	Background	CO, NO2, NOX, O3, PM10, PM2.5, SO2
GB0883A	suburban	Background	not given

3.3.4 Haifa

The spatial extent of Airbase does not include Haifa.

3.3.5 Ljubljana

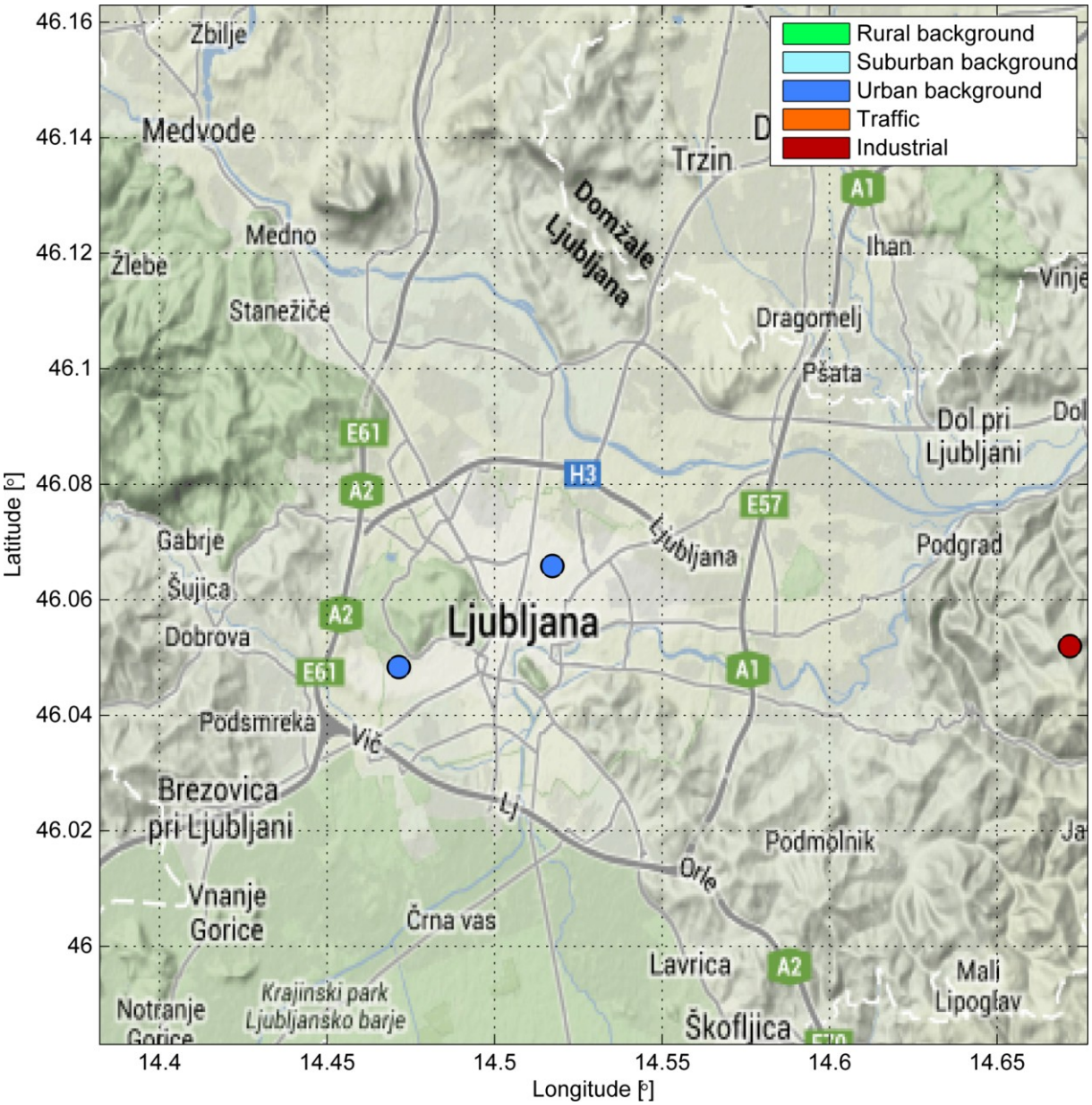

Figure 5: Map of Airbase stations located throughout the Ljubljana study site. Only stations indicated as currently operational in the database are shown.

Table 6: Airbase stations relevant for the Ljubljana study site and some basic metadata.

Station Code	Station Area	Station Type	Relevant Species measured
SI0003A	suburban	Background	CO, NO2, NOX, O3, PM10, SO2
SI0058A	suburban	Background	PM10, PM2.5
SI0051A	suburban	Background	NO2, NOX, PM10, SO2

3.3.6 Oslo

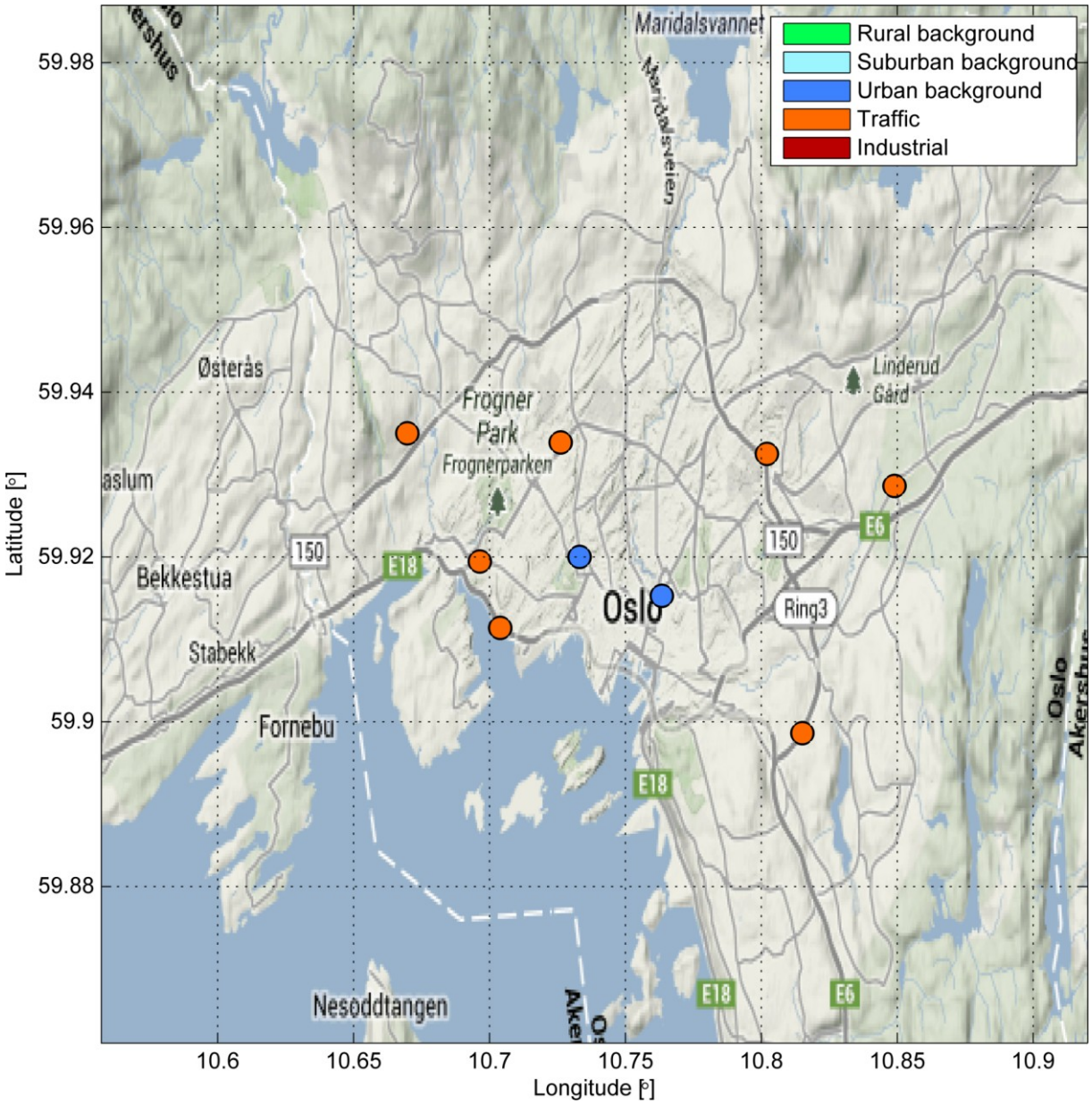

Figure 6: Map of Airbase stations located throughout the Oslo study site. Only stations indicated as currently operational in the database are shown.

Table 7: Airbase stations relevant for the Oslo study site and some basic metadata.

Station Code	Station Area	Station Type	Relevant Species measured
NO0088A	suburban	Background	NO2, O3
NO0072A	suburban	Background	PM10
NO0057A	suburban	Background	NO2, NOX, PM10, PM2.5
NO0083A	urban	Background	NO2, NOX, PM10, PM2.5
NO0093A	urban	Background	NO2, NOX, PM10, PM2.5

NO0011A	urban	Background	CO, NO2, NOX, PM10, PM2.5
NO0058A	urban	Background	NO2, NOX, PM10, PM2.5
NO0071A	urban	Background	NO2, NOX, PM10, PM2.5
NO0095A	urban	Background	not given

3.3.7 Ostrava

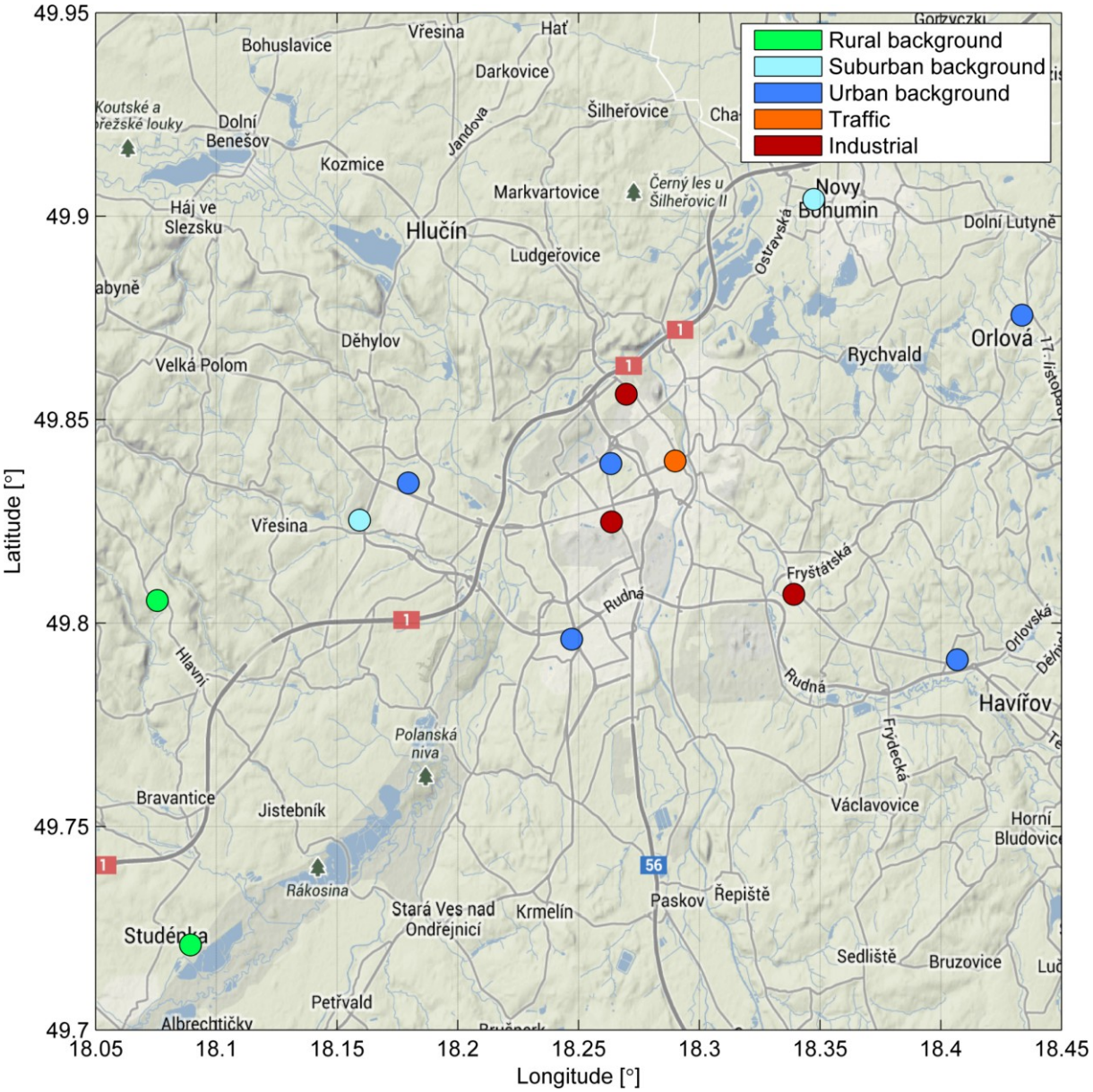

Figure 7: Map of Airbase stations located throughout the Ostrava study site. Only stations indicated as currently operational in the database are shown.

Table 8: Airbase stations relevant for the Ostrava study site and some basic metadata.

Station Code	Station Area	Station Type	Relevant Species measured
CZ0TSTD	suburban	Background	NO2, NOX, O3, PM10, SO2
CZ0TZBY	suburban	Background	PM10
CZ0TBOM	suburban	Background	NO2, NOX, PM10, PM2.5, SO2
CZ0TOPO	urban	Background	PM10, PM2.5
CZ0THAR	urban	Background	NO2, NOX, PM10, SO2
CZ0TORV	urban	Background	NO2, NOX, PM10, SO2
CZ0TOFF	urban	Background	CO, NO2, NOX, O3, PM10, PM2.5, SO2
CZ0TOPU	urban	Background	not given
CZ0TOZR	urban	Background	CO, NO2, NOX, PM10, PM2.5, SO2
CZ0TOCB	urban	Background	CO, NO2, NOX, PM10
CZ0TOMH	urban	Background	not given
CZ0TOPR	urban	Background	CO, NO2, NOX, O3, PM10, PM2.5, SO2
CZ0TOBA	urban	Background	not given

3.3.8 Vienna

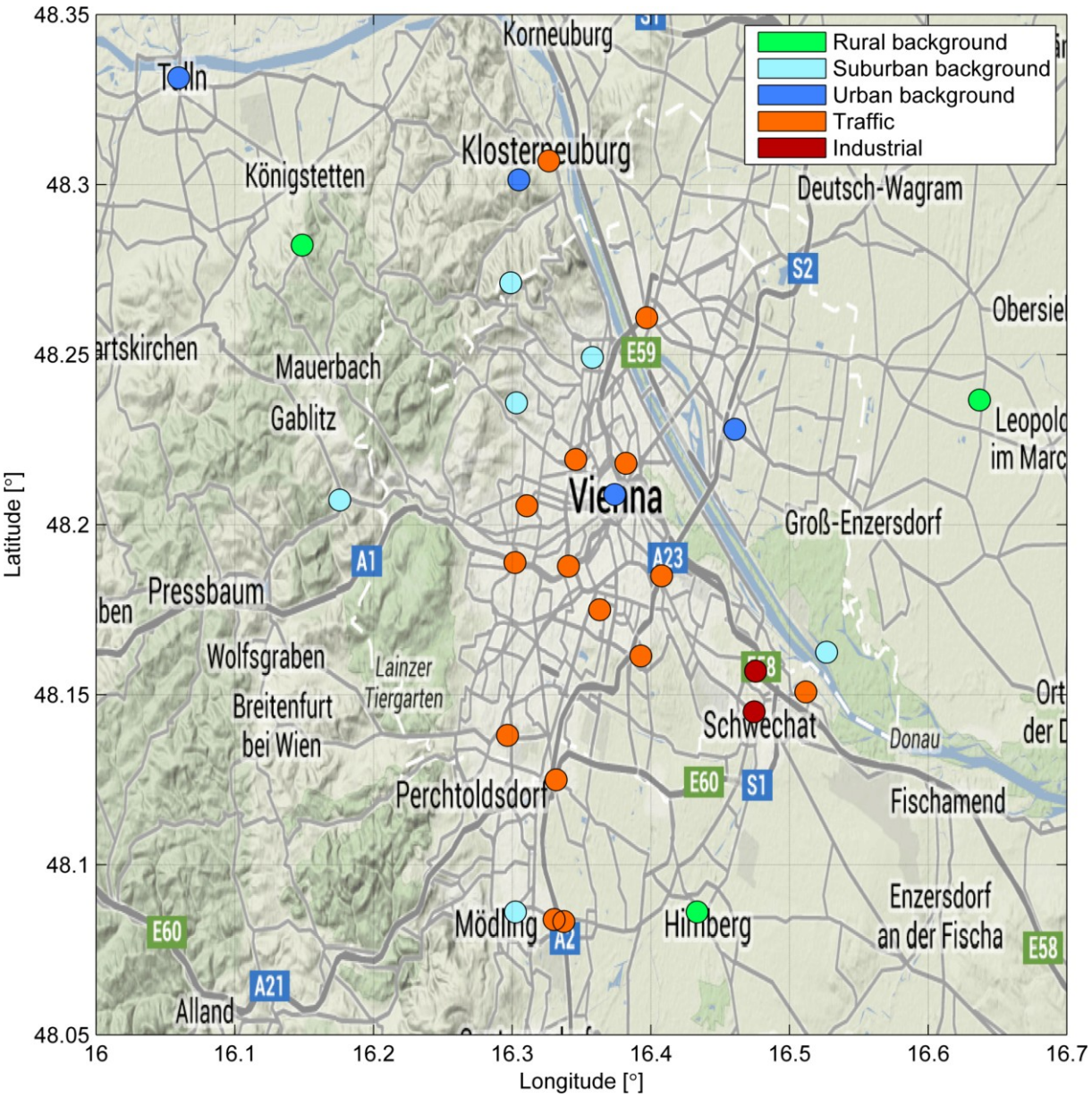

Figure 8: Map of Airbase stations located throughout the Vienna study site. Only stations indicated as currently operational in the database are shown.

Table 9: Airbase stations relevant for the Vienna study site and some basic metadata.

Station Code	Station Area	Station Type	Relevant Species measured
AT30407	suburban	Background	NO2, NOX, O3, PM10, SO2
AT30603	suburban	Background	NO2, NOX, O3, PM10, SO2
AT31906	suburban	Background	NO2, NOX, SO2
AT31401	urban	Background	CO, NO2, NOX, O3, PM10, SO2
AT30065	urban	Background	NO2, NOX, O3, PM10, SO2
AT9JAEG	urban	Background	NO2, NOX, O3, SO2

AT900ZA	urban	Background	NO2, NOX, O3, SO2
AT90LOB	urban	Background	NO2, NOX, O3, PM10, SO2
AT9SCHA	urban	Background	NO2, NOX, PM10, SO2
AT30601	urban	Background	NO2, NOX, O3, PM10, SO2
AT31901	urban	Background	NO2, NOX, O3, PM10, SO2
AT9STAD	urban	Background	CO, NO2, NOX, PM10, SO2
AT9STEF	urban	Background	NO2, O3, SO2
AT31406	urban	Traffic	NO2, NOX, O3, PM10
AT30599	urban	Traffic	NO2, NOX, PM10
AT32702	urban	Traffic	NO2, NOX, PM10
AT31402	urban	Traffic	CO, NO2, NOX, O3, PM10, SO2
AT9BELG	urban	Traffic	NO2, PM10, SO2
AT90FLO	urban	Traffic	NO2, NOX, PM10, SO2
AT9GAUD	urban	Traffic	CO, NO2, NOX, PM10, SO2
AT90MBA	suburban	Traffic	CO, NO2, SO2
AT9KEND	urban	Traffic	NO2, NOX, PM10, SO2
AT90LAA	suburban	Traffic	NO2, NOX, O3, PM10, SO2
AT9LIES	suburban	Traffic	NO2, NOX, PM10, SO2
AT9RINN	urban	Traffic	CO, NO2, NOX, PM10, SO2
AT90TAB	urban	Traffic	CO, NO2, PM10, PM2.5, SO2
AT90AKC	urban	Traffic	CO, NO2, NOX, PM10, PM2.5, SO2
AT31413	urban	Traffic	NO2, NOX, PM10
AT32701	urban	Traffic	CO, NO2, NOX, O3, PM10, SO2
AT900KE	suburban	Traffic	CO, NO2, NOX, PM10, SO2

3.4 Data Accessibility

The entire AirBase database can be downloaded in full from the website http://www.eea.europa.eu/data-and-maps/data/airbase-the-european-air-quality-database-6 (the URL might change with the more current version of the database). Note the database contains only data until the previous year. Therefore, while this data access method is extremely valuable for automated comprehensive analyses involving a large number of stations, it is not suitable for obtaining near real-time (NRT) data.

Unvalidated NRT data are also available from the EEA. These data can, for example, be accessed in map form at http://www.eea.europa.eu/themes/air/air-quality/map/real-time-map. See Figure 9 for a screenshot showing the web interface for the provision of air quality data. The actual raw NRT data can, for example, be accessed by scripts using the SPARQL Protocol and RDF Query Language (SPARQL) for which the service is provided at http://cr.eionet.europa.eu/sparql.

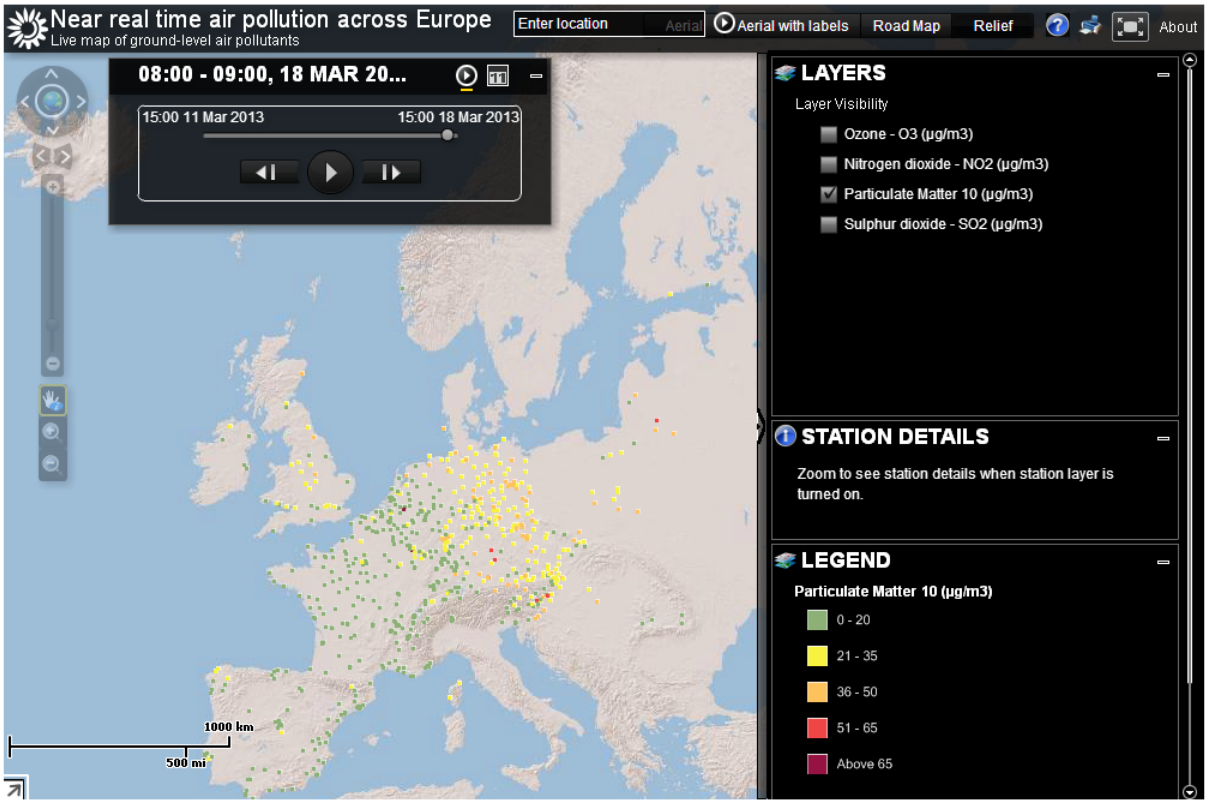

Figure 9: A web interface operated by the EEA provides a visual interface for unvalidated near real time air quality data in Europe. Note that accessing the actual raw data requires a scripting approach.

4 Data provided by the European Monitoring and Evaluation Programme (EMEP)

4.1 Overview

The European Monitoring and Evaluation Programme (EMEP) is a scientifically based and policy driven programme under the Convention on Long-range Transboundary Air Pollution (CLRTAP) for international co-operation to solve transboundary air pollution problems. Measurements of air quality are performed within the framework of EMEP at regional monitoring sites across Europe. The data is quality controlled before submission to the EMEP Chemical Coordinating Centre (EMEP-CCC) at the Norwegian Institute for Air Research (NILU).

4.2 Available Data

The primary focus of the EMEP monitoring network is on background concentrations. For this reason most stations within the framework of the EMEP monitoring programme are located in rural areas. While these stations are not located within the city areas of the eight study sites (see Section 3.2 above), such sites can still be useful for data assimilation/data fusion purposes as such tasks are generally carried out on a larger domain than just the city itself. EMEP stations can potentially provide information on the rural background conditions in the surroundings of the city.

Figure 10 shows a map with the location of the air quality monitoring stations that have been providing data within the EMEP monitoring programme in the year 2010. A complete list of EMEP stations can be found in the Appendix in Table 12.

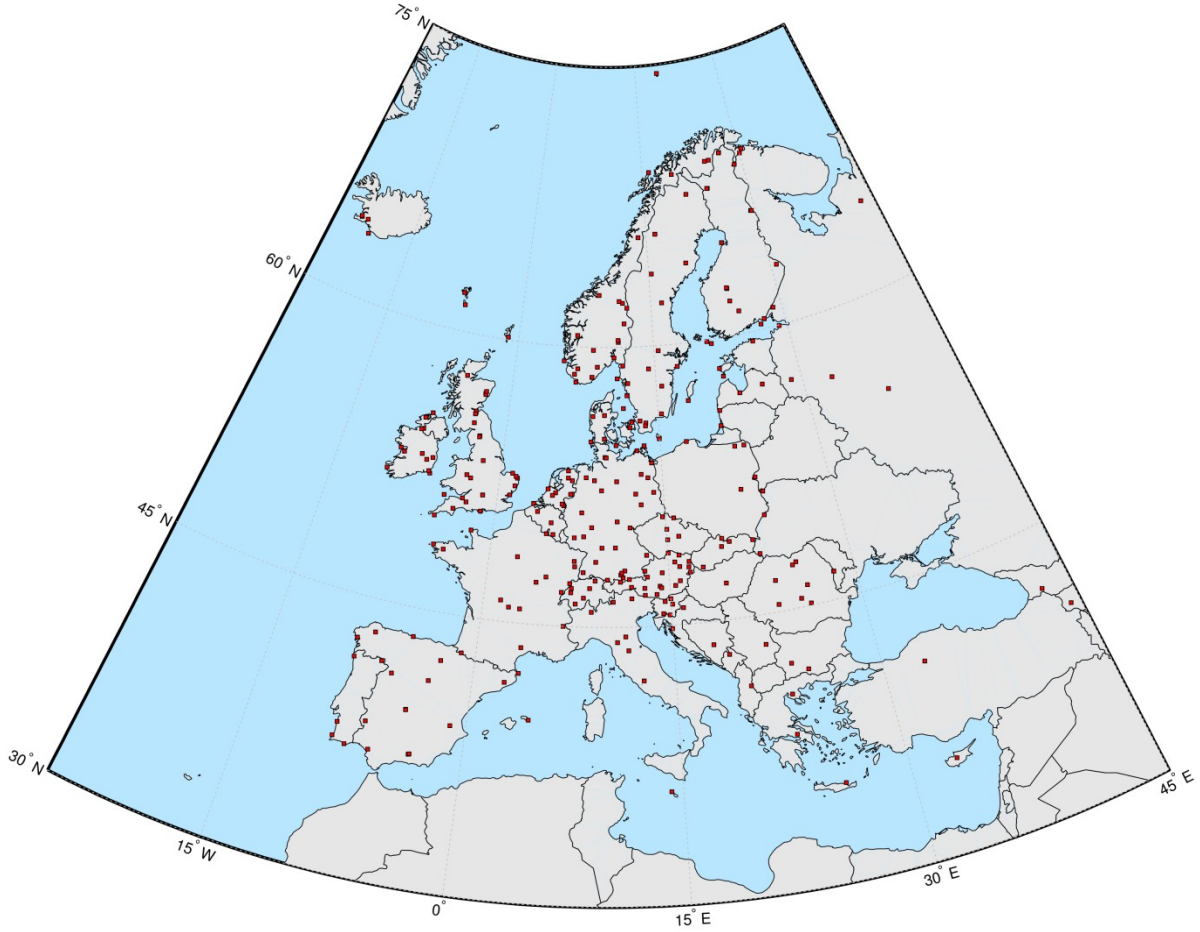

Figure 10: Overview of the locations of all European air quality stations that provide data within the EMEP observation network. Note not all stations operate all the time.

4.3 Data accessibility

EMEP data can be accessed through the EBAS website operated by NILU (http://ebas.nilu.no/). Figure 11 shows a screen shot of the EBAS interface. EMEP data can be acquired by selecting "EMEP" under the list of Frameworks. Subsequently, the user can filter by country, specific stations, species, instrument types, or component type. After filtering, the number of datasets matching the criteria is shown in the lower right hand of the screen and can be displayed by clicking the "List datasets" button. Subsequently, the user can select the dataset of interest and download it formatted in the ASCII-based *NASA Ames Format for Data Exchange*.

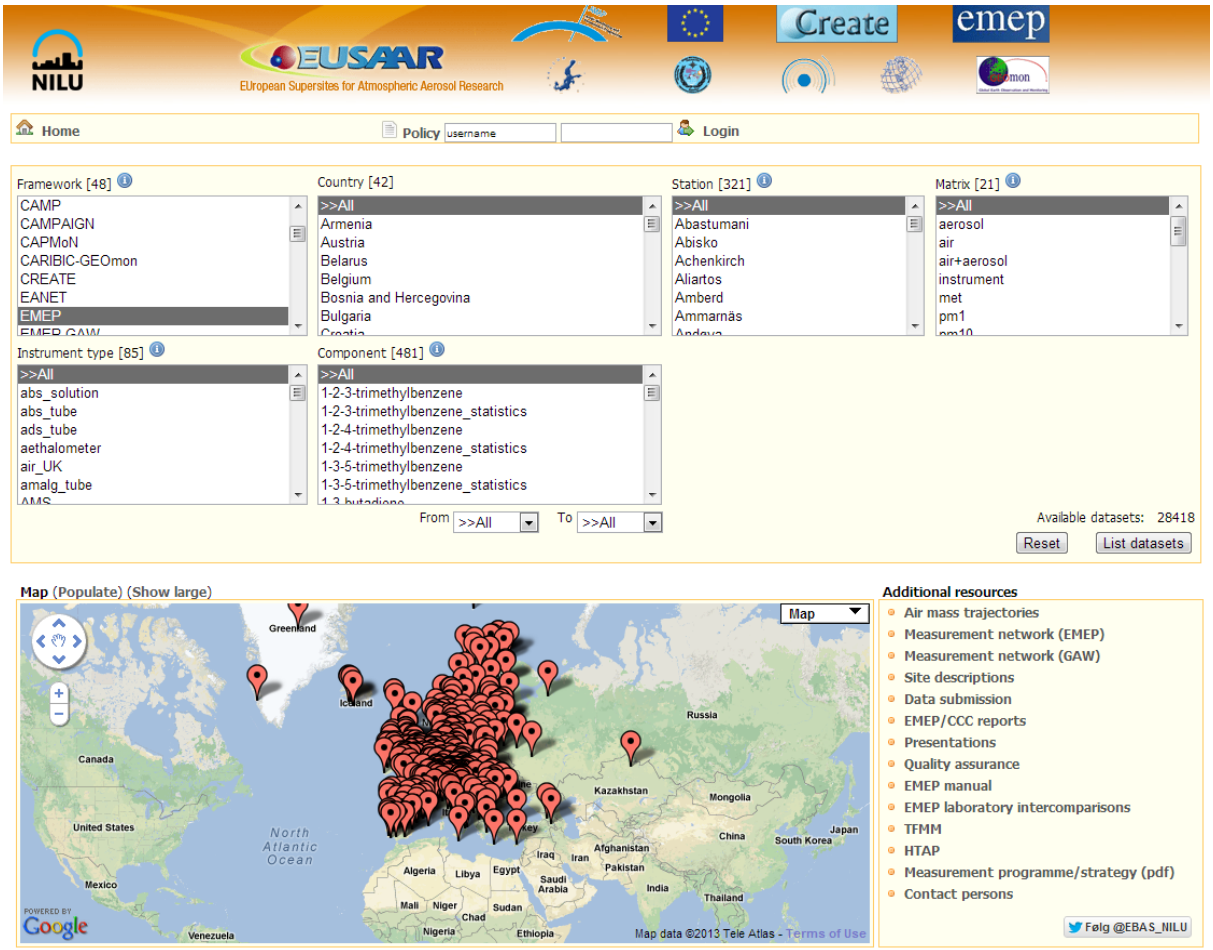

Figure 11: Screenshot of the EBAS web interface for accessing EMEP monitoring data. The EBAS interface is maintained by NILU at http://ebas.nilu.no/.

5 Other metadata

The main purpose of WP6 is to provide a metadata compilation for datasets that can be used within other WP6 tasks. Therefore, selection of potential data sources has been limited to those that are feasible for use within a data assimilation scheme at city level (the resolution at which WP2 and WP3 will provide their data). This selection was based on the criteria listed in Section 2.2.

However, other metadata that might not fulfil all listed criteria could still be useful within the CITI-SENSE project, for example for other work packages besides WP6. In this section we provide additional information on other datasets that have the potential to be useful to CITI-SENSE.

5.1 PASODOBLE

The PASODOBLE project is part of the European Earth Observation Programme (Copernicus, formerly known as GMES, the Global Monitoring for Environment and Security initiative) and aims to provide information and support for regions and cities that are affected by air pollution. Detailed information can be found on the project website at http://www.myair.eu/.

Some of the services provided by PASODOBLE could be useful for data fusion and data assimilation tasks with respect to the data collected by CITI-SENSE. Table 3 gives an overview of the public information services on air quality provided by PASODOBLE.

Table 10: Products and services related to public air quality information, as provided by the PASODOBLE project. Products that could be useful for the eight CITI-SENSE pilot locations are highlighted in red.

Service Line	Service		European region / city / cities covered	Service provider*	Products
Public information on air quality	Regional AQ Services	Regional AQ Service for Fennoscandia and the Baltics	Fennoscandia and the Baltic area	FMI	Hourly concentration and deposition maps for Northern Europe
		Regional AQ service for the Balkan Peninsula	Balkan Peninsula	AUTH	72-hr forecast of pollutant concentrations over South-East Mediterranean at 10 km horizontal resolution
		Regional AQ forecast for the Black Sea Area	Black Sea area	FRIUUK	AQ forecast for the Black Sea area
		Regional AQ service for The Netherlands and the Dutch provinces	The Netherlands & Dutch provinces	KNMI	Analysis and forecast of hourly values (spatially gridded) of several pollutant mass concentrations, most importantly PM_{10}, O_3, $NO_2$and SO_2
		Regional AQ forecast for Belgium	Belgium	VITO	Daily 72-hr AQ forecasts
		Regional AQ forecast for North Rhine-Westphalia	North Rhine-Westphalia (Germany)	FRIUUK	AQ forecast, AQ index and AQ analysis for North Rhine-Westphalia
		Regional AQ service for Southern Germany	Southern Germany	DLR	Forecast of air pollutant surface concentrations
		Meso-scale AQ forecast service for the Ruhr area	Ruhr area (Germany)	FRIUUK	AQ forecast, AQ index and AQ analysis for the Ruhr area
	Urban AQ Services	High-resolution AQ service for Balkan cities	Athens, Thessaloniki (Greece)	AUTH	72-hr forecast of pollutant concentrations over Athens and Thessaloniki at 2 km horizontal resolution
		Urban AQ forecast for five Belgian cities	Antwerp, Brussels, Charleroi, Ghent, Liège (Belgium)	VITO	72-hr ahead forecast of daily mean mass concentrations of PM10 & PM2.5 and daily maximum mass concentrations of O_3& NO_2, as

					well as retrospective assessments for Brussels
		Urban AQ forecast for Prague	Prague (Czech Republic)	VITO	72-hr ahead forecast of daily mean mass concentrations of PM_{10} & $PM_{2.5}$ and daily maximum mass concentrations of O_3& NO_2
		Urban AQ forecast for Bratislava	Bratislava (Slovakia)	VITO	72-hr ahead forecast of daily mean mass concentrations of PM_{10} & $PM_{2.5}$ and daily maximum mass concentrations of O_3& NO_2
		Urban AQ forecast for London	London (UK)	CERC	Daily environmental bulletins for the public

Most of the products and services are accessed through the PASODOBLE/Myair main server at http://www.myair.eu/geonetwork/srv/en/main.home.

As can be seen from Table 10, the PASODOBLE products and services are targeted either towards particular regions or individual cities. No products or services are available for the entire European continent, which makes their automated use challenging for all study sites in WP2 and WP3: However, individual sites might still benefit from the data.

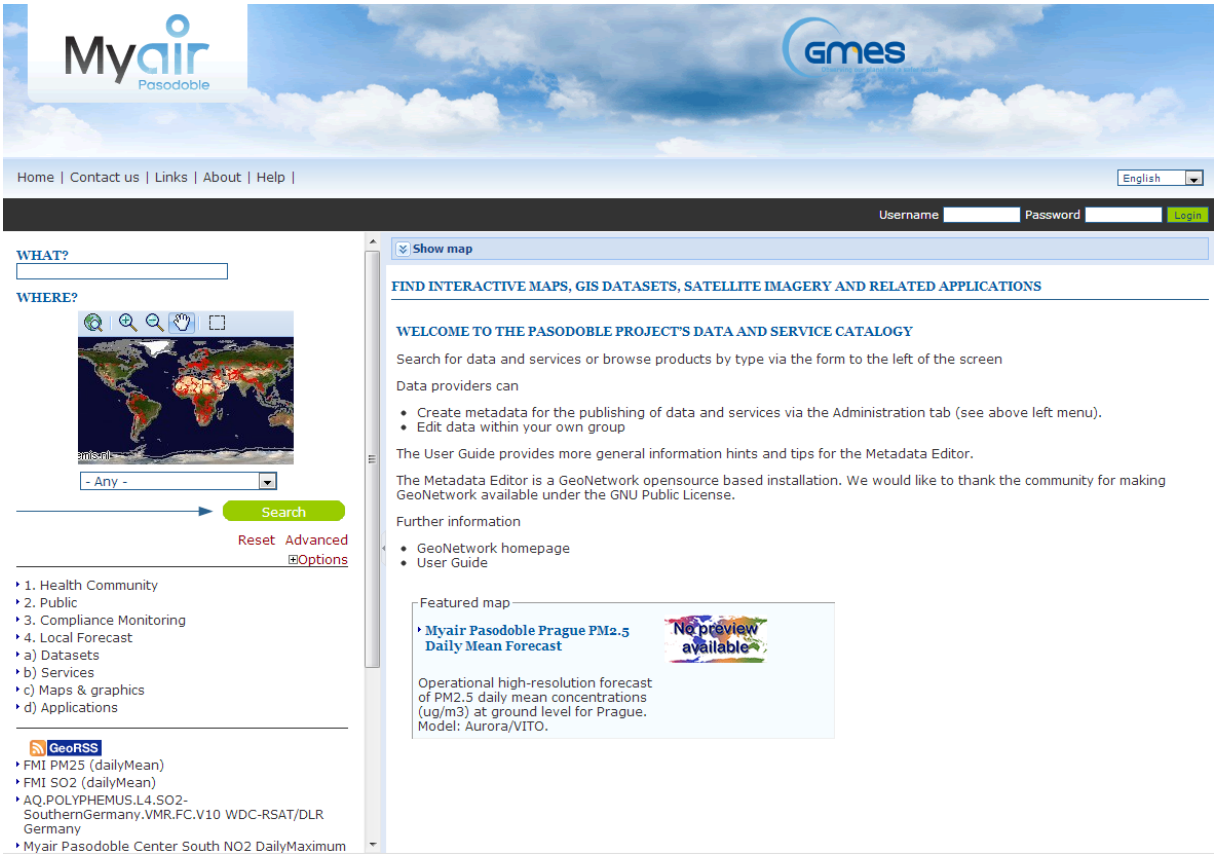

Figure 12: The interactive tool for finding data and products produced within the framework of the PASODOBLE project.

5.2 MACC-II

Monitoring Atmospheric Composition and Climate - Interim Implementation (MACC-II) is the pre-operational implementation of the Atmospheric Service of Copernicus. The project provides data and

services on atmospheric composition for recent years, monitoring of present conditions, as well as forecasts of the spatial and temporal distribution of key constituents. The services are focused on global atmospheric composition with respect to aerosols, reactive gases, greenhouse gases, and their respective sources. Specific information about the project and its products and services can be found at the project website under http://www.copernicus-atmosphere.eu/.

MACC-II uses a global monitoring and forecasting system which estimates the state of the atmosphere using both observations and models. It provides a wide variety of products and services relevant to air quality applications and, therefore, for CITI-SENSE. The model output of atmospheric composition provided by the MACC-II project has a particularly high potential for the data assimilation tasks in WP6 as they provide spatially continuous fields for all the relevant parameters. While the output of the global products generally has too coarse a spatial resolution to be useful for data assimilation tasks with the microsensor data produced within the CITI-SENSE WPs 2 and 3, the MACC-II project also has a regional component for which chemical transport models are run at spatial resolutions down to 7 km x 7 km, which is fine enough to consider such output for data assimilation tasks with CITI-SENSE WP6 (note this spatial resolution need not be the one used in data assimilation efforts in CITI-SENSE). Further increases in spatial resolution of the regional component are planned in the upcoming years.

Figure 9 shows an example of the web interface provided by the MACC-II project, which gives access to a wide variety of products. A comprehensive overview of all available products and services

currently provided by MACC-II is given in Table 13 in the Annex.

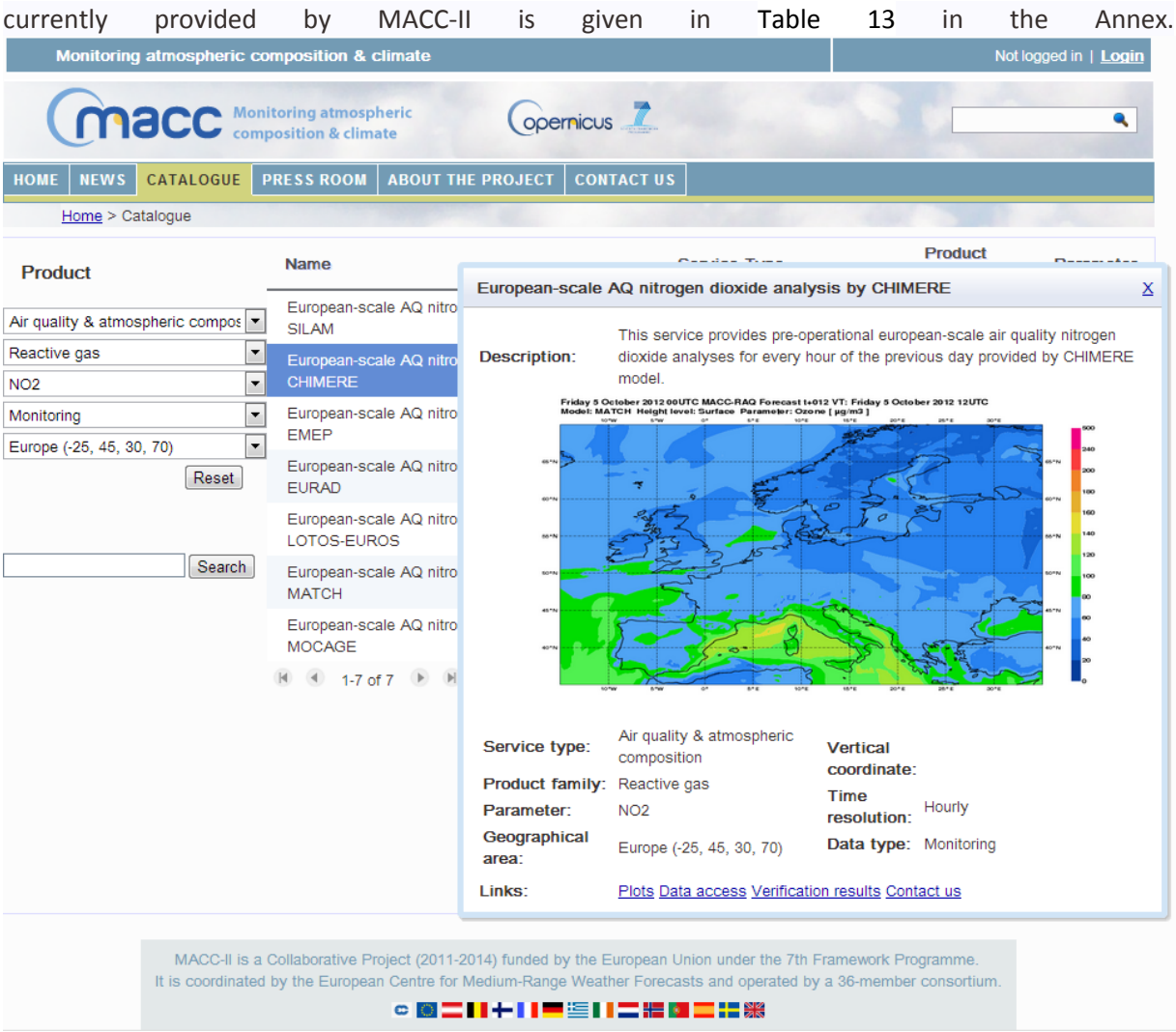

Figure 13: Screenshot showing the standard interface of the MACC-II product catalogue. Through this interface the project provides access to, among others, a vast array of air quality related products, and in particular modelling output.

5.3 Local AQ models

A brief survey was carried out among location officers of CITI-SENSE WP2 in order to acquire information about already existing locally operated air quality models with the potential to be used as an auxiliary dataset within WP6 data assimilation tasks.

The questions posed to the CITI-SENSE location officers were:

1. Is a local high-resolution air quality model being run (more or less) operationally for your location?
2. Which model? (Name, Creator)
3. Who or which institution is operating the model?
4. At what spatial resolution?

5. At what temporal resolution?
6. Which species are modelled?
7. How can the model output be accessed? Is it available for the public? Within CITI-SENSE?
8. Is the system described on a website? Where?
9. Who is a potential contact person for further questions?
10. Any other related metadata you can share?

We received feedback from five locations. A summary of the information provided by the location officers is given in the following sections.

5.3.1 Barcelona

Barcelona operates a Land-Use Regression model (LUR) created by CREAL within the ESCAPE project. It is operated by CREAL and used at point-scale resolution, i.e., estimates are carried out for any location within the study area. The model was originally created to compute annual averages, but its temporally resolution can be adjusted to also provide daily and weekly resolution. The species modelled are NO_2, NO_x, $PM_{2.5}$, PM_{10}, and PM coarse fraction.

Access to the model output is restricted to internal projects carried out at CREAL. The data are not available to the public, however access within the CITI-SENSE project could be provided.

Further details and a more comprehensive description of the model are given at http://www.escapeproject.eu/manuals/index.php.

5.3.2 Haifa

The NILU-developed AirQUIS model has been used in Haifa as a Now-cast system. It combines observed air quality data with model simulations to produce assimilated fields for the components NO_2, NO_X, PM10, SO_2, and O_3 as well as calculating the Air Quality Index (AQI).

The input to the system was archived traffic data, archived stack emission data, updated meteorological data, updated air quality observational data, and updated stack emission data.

These data were then sent to the EPISODE dispersion model which calculates 2 half-hourly concentration fields every hour using an emission model for traffic and point sources, an Eulerian grid model, the INPUFF Gaussian puff model, and the HIWAY line source model for traffic.

The simulated concentration fields are then sent to the assimilation module which adjusts model results using updated observational data interpolated onto the model domain. This module uses local positional adjustment, a scaling factor calculation, observational field interpolation, a weighting factor field calculation, and assimilation of model and observed fields.

The Air Quality Index calculation is then computed using assimilated field calculations for NO_X, PM10, and SO_2, as well as O_3 observed field calculations.

Half hourly maps and data are then generated within the AirQUIS system to be sent to the website. These consist of fields for NO_2, PM_{10}, SO_2, AQI and receptor point values for NO_2, PM_{10}, SO_2, and AQI.

In addition to the half hourly maps, AirQUIS also sends the following information to the website: 1) the number of people in Haifa exposed to poor air quality; 2) a text giving the current status of the system; and 3) a log file giving details of the assimilation routine.

The system is currently not operational.

5.3.3 Prague

Air quality modelling is carried out for the entire Czech Republic using the Gaussian dispersion model SYMOS97. Most of the air quality modelling in the Czech Republic is performed by the Czech Hydrometeorological Institute (CMHI), however, some modelling activities are also carried out by the Technical University of Ostrava using SYMOS 97. Some modelling studies are also done using the CAMx and EMEP models. Furthermore, ETC/ACM gridded maps of air pollution for all of Europe are produced by CMHI on an operational basis.

The modelled species within SYMOS 97 operated at CMHI are: SO_2, PM_{10}, $PM_{2.5}$, NO_2, NO_x, CO, O_3, Cd, As, Ni, and B[a]P. At the Technical University of Ostrava, PM_{10}, NO_2, SO_2, Benzo(a)pyrene (B[a]P), and As are the main species modelled.

More information about the model can be found at http://old.chmi.cz/uoco/prj/model/index.html (in Czech).

5.3.4 Ljubljana

In Ljubljana, Slovenia, most of air quality modelling is performed by the Slovenian Environment Agency. At the time of writing this report no further details were available, however more information will be provided by the respective location officer in the future.

5.3.5 Oslo

The Norwegian Meteorological Institute (Met Norway) and the Norwegian Institute for Air Research (NILU) collaborate to produce daily air quality forecasts for 6 of the largest cities in Norway. The forecasting system makes a 48 hour forecast for NO_2, PM_{10} and $PM_{2.5}$. The basis for the forecasting system is a combination of the Met Norway meteorological model HARMONIE and the NILU dispersion model AirQUIS. The air quality forecast is distributed to the city municipalities, which in turn inform the public through the internet and local media.

5.4 UV Database

NILU operates a web service providing information about ultraviolet (UV) radiation within Norway. The service is a cooperation between NILU, the Climate and Pollution Agency of Norway, the Norwegian Cancer Society, the Storm Weather Service, the Norwegian Meteorological Institute (Met Norway), and the Norwegian Radiation Protection Authority.

The simulated UV forecasts and nowcasting data are currently calculated daily on a NILU server and are displayed on the website uv.nilu.no. The UV simulations are calculated using the FastRT UV simulation package (Engelsen and Kylling, 2005) with input parameters produced by the US-based NCEP (National Centers for Environmental Prediction) weather prediction model data as supplied by

stormgeo.com. In the framework of CITI-SENSE, it is planned to improve and expand the UV forecasts by providing UV radiation intensities throughout the day, not only at local noon.

A screenshot illustrating the interface and data available at the UV web service is shown in Figure 14. The user can enter a site name within Norway in the search field of the interface and is subsequently provided with a forecast of the UV index for various weather and snow conditions. The forecast is provided for either the same day or up to two days in advance. The web service provides an explanation of the various UV index levels.

The forecasts are complemented by time series of UV and ozone observations from stations throughout Norway (Oslo, Landvik, Bergen, Trondheim, Andøya, and Ny Ålesund). The observational database is updated at 15:00 (local time) every day.

5.5 Pollen Data

A further environmental parameter that may be considered in CITI-SENSE for the eight city pilot studies (see section 3.2 above) is pollen data. As an example of what is available in Europe, Norway provides pollen forecasts during the pollen season (see http://www.pollenvarslingen.no/forsiden/varsel.aspx for more information). The pollen forecasts are made by scientists at NAAF, but the website and database are hosted by NILU. The forecast is updated every day. Pollen forecasts are provided through the web-application, by e-mail and may also be got through an app (”pollen-app”). The Norwegian media can receive the forecast via an xml-feed – used now by yr.no and most newspapers in Norway.

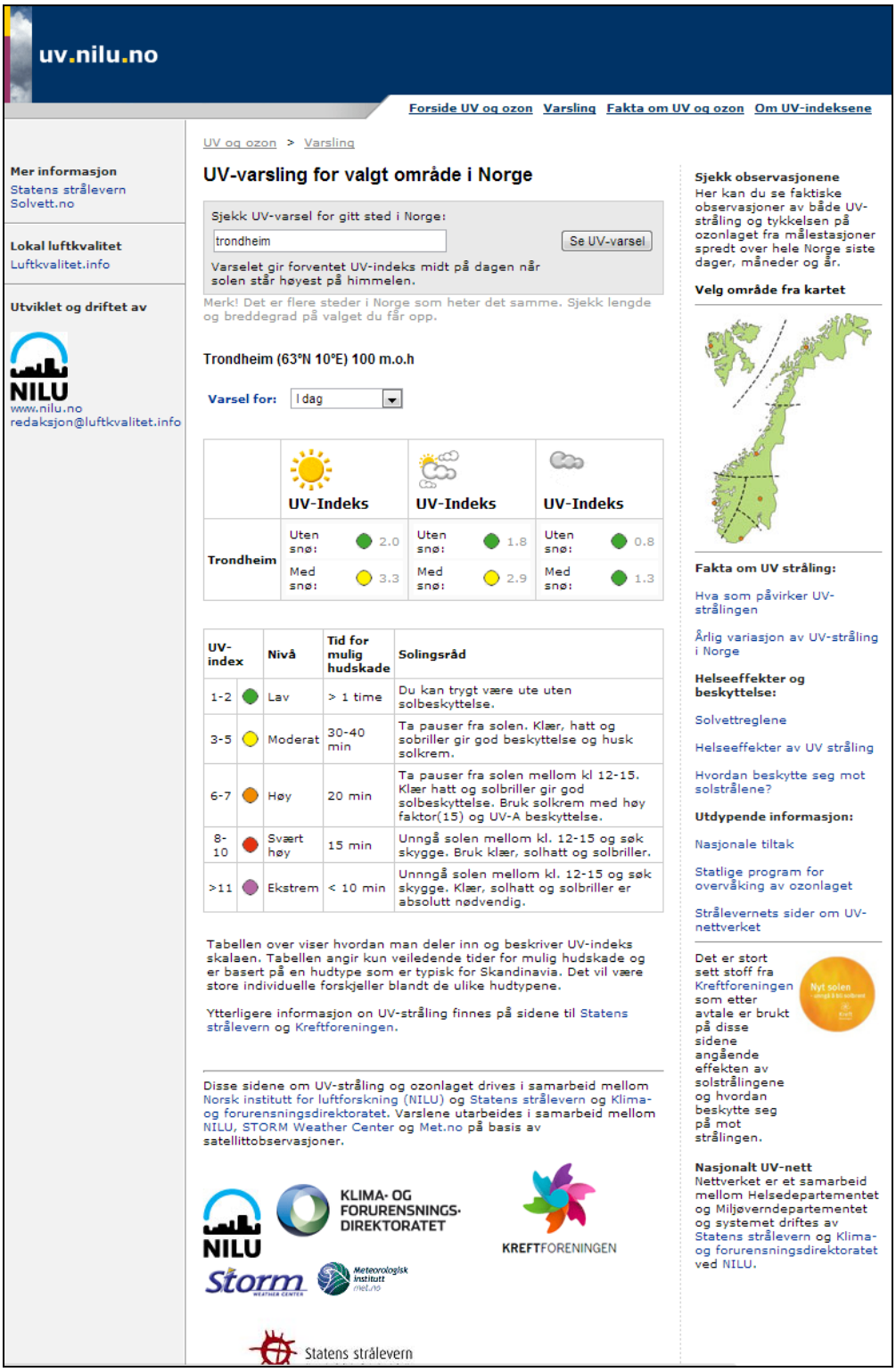

Figure 14: Screenshot of the UV web service operated by NILU at http://uv.nilu.no/

6 INSPIRE Directive

The INSPIRE Directive (European Parliament, 2007), ratified in May 2007, is an "EU initiative to establish an infrastructure for spatial information in Europe that will help to make spatial or geographical information more accessible and interoperable for a wide range of purposes supporting sustainable development". The Directive is currently implemented in various stages, with full implementation expected by 2019.

The INSPIRE directive addresses 34 spatial themes that are needed for environmental applications. These themes are organized within 3 Annexes (Drafting Team Data Specifications, 2008):

Annex I contains the following themes:

1. Coordinate reference systems
2. Geographical grid systems
3. Geographical names
4. Administrative units
5. Addresses
6. Cadastral parcels
7. Transport networks
8. Hydrography
9. Protected sites

The following themes are covered in Annex II:

1. Elevation
2. Land cover
3. Orthoimagery
4. Geology

Annex 3 covers the following themes:

1. Statistical units
2. Buildings
3. Soil
4. Land use
5. Human health and safety
6. Utility and governmental services
7. Environmental monitoring Facilities
8. Production and industrial facilities
9. Agricultural and aquaculture facilities
10. Population distribution and demography
11. Area management / restriction / regulation zones & reporting units
12. Natural risk zones
13. Atmospheric conditions
14. Meteorological geographical features
15. Oceanographic geographical features
16. Sea regions

17. Bio-geographical regions
18. Habitats and biotopes
19. Species distribution
20. Energy Resources
21. Mineral Resources

The INSPIRE directive is based on the following list of principles (as written in the INSPIRE website):

- Data should be collected only once and kept where it can be maintained most effectively;
- It should be possible to combine seamless spatial information from different sources across Europe and share it with many users and applications;
- It should be possible for information collected at one level/scale to be shared with all levels/scales; detailed for thorough investigations, general for strategic purposes;
- Geographic information needed for good governance at all levels should be readily and transparently available;
- It should be easy to find what geographic information is available; how it can be used to meet a particular need; and under which conditions it can be acquired and used.

Detailed information about the INSPIRE Directive can be found at the INSPIRE website at http://inspire.jrc.ec.europa.eu/.

In terms of metadata, the most relevant INSPIRE document is "INSPIRE Metadata Implementing Rules: Technical Guidelines based on EN ISO 19115 and EN ISO 19119" (http://inspire.jrc.ec.europa.eu/documents/Metadata/INSPIRE_MD_IR_and_ISO_v1_2_20100616.pdf). It provides a detailed listing of recommended metadata elements, as required by ISO standards 19115 and 19119.

7 Placeholder for future updates

This section will be used to include additional metadata in future versions of this document. This will include datasets that could not be considered during the initial preparation of this deliverable, either because they were not available or because their need only became clear later in the project.

References

CREAL, 2013. WP2 pilot case protocol compilation. CITI-SENSE Deliverable D2.1.

Drafting Team "Data Specifications", 2008. *Definition of Annex Themes and Scope*, INSPIRE - Infrastructure for Spatial Information in Europe. http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/DataSpecifications/D2.3_Definition_of_Annex_Themes_and_scope_v3.0.pdf

Engelsen, O. and A. Kylling (2005): Fast simulation tool for ultraviolet radiation at the earth's surface. Optical Engineering, 44(4), 041012.1-7.

European Parliament (2007): Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE). Official Journal of the European Union 108/1, p. 1–14, 25.4.2007.

ANNEX

Table 11: List of Airbase components as given in version 6 of the Airbase database. Note that the vast majority of the listed components are only available at very few stations. Components that individually make up at least 5% of the entire dataset, i.e., the primarily measured components, are shown in bold - and these are the main ones that are relevant for CITI-SENSE. Most of the other components make up less than 0.5% of the dataset.

Code	Coponent name	Unit
1	**Sulphur dioxide (air)**	**µg/m3**
3	Strong acidity (air)	µg SO2/m3
4	Total suspended particulates (aerosol)	µg/m3
5	**Particulate matter < 10 µm (aerosol)**	**µg/m3**
6	Black smoke (air)	µg/m3
7	**Ozone (air)**	**µg/m3**
8	**Nitrogen dioxide (air)**	**µg/m3**
9	**Nitrogen oxides (air)**	**µg NO2/m3**
10	**Carbon monoxide (air)**	**mg/m3**
11	Hydrogen sulphide (air)	µg/m3
12	Lead (aerosol)	µg/m3
13	Mercury (aerosol)	ng/m3
14	Cadmium (aerosol)	ng/m3
15	Nickel (aerosol)	ng/m3
16	Chromium (aerosol)	ng/m3
17	Manganese (aerosol)	ng/m3
18	Arsenic (aerosol)	ng/m3
19	Carbon disulphide (air)	µg/m3
20	Benzene (air)	µg/m3
21	Toluene (air)	µg/m3
22	Styrene (air)	µg/m3
24	1.3 Butadiene (air)	µg/m3
25	Formaldehyde (air)	µg/m3
26	Trichloroethylene (air)	µg/m3
27	Tetrachloroethylene (air)	µg/m3
29	Benzo(a)pyrene (precip)	ng/l
30	Polyaromatic hydrocarbons (air+aerosol)	ng/m3
32	Total non-methane hydrocarbons (air)	µg C/m3
33	Total volatile organic compounds (air)	µg/m3
34	Peroxyacetyl nitrate (air)	µg/m3
35	Ammonia (air)	µg/m3
36	Wet nitrogen deposition (flux)	mg N/m2.m
37	Wet sulphur deposition (flux)	mg S/m2.m

38	**Nitrogen monoxide (air)**	**µg/m3**
39	Hydrogen chloride (air)	µg/m3
40	Hydrogen fluoride (air)	µg/m3
41	Methane (air)	µg/m3
45	Particulate ammonium (aerosol)	µg/m3
46	Particulate nitrate (aerosol)	µg/m3
47	Particulate sulphate (aerosol)	µg/m3
48	Selenium (aerosol)	ng/m3
49	Vanadium (aerosol)	ng/m3
51	HC C2-C6(excl. AROM. & CHLH) (air+aerosol)	µg/m3
53	Aromatics (except C6H6) (air)	µg/m3
62	Fluoride (except HF) (air)	µg/m3
63	Zinc (aerosol)	ng/m3
64	Cobalt (aerosol)	ng/m3
65	Iron (aerosol)	ng/m3
67	Total nitrate (air+aerosol)	µg N/m3
68	Total ammonium (air+aerosol)	µg N/m3
69	Radioactivity ()	[]
71	Carbon dioxide (air)	ppmv
73	Copper (aerosol)	ng/m3
316	i-Hexane (2-methylpentane) (air)	µg/m3
323	N3methylpentane (air)	pptv
351	acenaphthene (air+aerosol)	ng/m3
352	acenaphtylene (air+aerosol)	ng/m3
380	Benzo(b+j+k)fluoranthenes (air+aerosol)	ng/m3
381	Benzo(e)pyrene (air+aerosol)	ng/m3
394	n-Butane (air)	µg/m3
406	chrysene (precip)	ng/l
412	conductivity (precip)	uS/cm
416	cyclohexane (air)	pptv
428	Ethane (air)	µg/m3
430	Ethene (Ethylene) (air)	µg/m3
431	Ethyl benzene (air)	µg/m3
432	Ethyne (Acetylene) (air)	µg/m3
435	fluorene (air+aerosol)	ng/m3
441	n-Heptane (air)	µg/m3
443	n-Hexane (air)	µg/m3
447	i-Butane (2-methylpropane) (air)	µg/m3
449	i-Octane (2,2,4-trimethylpentane) (air)	µg/m3
450	i-Pentane (2-methylbutane) (air)	µg/m3
451	Isoprene (2-methyl-1,3-butadiene) (air)	µg/m3
464	m,p-Xylene (air)	µg/m3
465	naphtalene (air+aerosol)	ng/m3

475	n-Octane (air)	µg/m3
482	o-Xylene (air)	µg/m3
486	n-Pentane (air)	µg/m3
503	Propane (air)	µg/m3
505	Propene (air)	µg/m3
517	sum_PCB (precip)	ng/l
520	sum_sulph_diox_sulphate (air+aerosol)	µg S/m3
604	aluminium (aerosol)	ng/m3
606	anthracene (air+aerosol)	ng/m3
608	anthracene (precip+dry_dep)	µg/m2/day
609	Benzo(a)anthracene (air+aerosol)	ng/m3
611	Benzo(a)anthracene (precip+dry_dep)	µg/m2/day
616	Benzo(b)fluoranthene (air+aerosol)	ng/m3
618	Benzo(b)fluoranthene (precip+dry_dep)	µg/m2/day
622	Benzo(ghi)perylene (air+aerosol)	ng/m3
624	Benzo(ghi)perylene (precip+dry_dep)	µg/m2/day
625	Benzo(k)fluoranthene (air+aerosol)	ng/m3
627	Benzo(k)fluoranthene (precip+dry_dep)	µg/m2/day
629	calcium (aerosol)	µg/m3
630	calcium (precip)	mg/l
631	chloride (aerosol)	µg/m3
632	chloride (precip)	mg/l
643	fluoranthene (air+aerosol)	ng/m3
645	fluoranthene (precip+dry_dep)	µg/m2/day
648	acidity(H+) (precip)	ue H/l
653	reactive_mercury (air+aerosol)	pg/m3
654	indeno_123cd_pyrene (air+aerosol)	ng/m3
656	indeno_123cd_pyrene (precip+dry_dep)	µg/m2/day
658	potassium (precip)	mg/l
660	magnesium (precip)	mg/l
664	ammonium (precip)	mg N/l
666	nitrate (precip)	mg N/l
669	sodium (precip)	mg/l
673	PCB_114 (air+aerosol)	pg/m3
674	PCB_118 (air+aerosol)	pg/m3
677	PCB_138 (air+aerosol)	pg/m3
679	PCB_141 (air+aerosol)	pg/m3
680	PCB_153 (air+aerosol)	pg/m3
683	PCB_157 (air+aerosol)	pg/m3
684	PCB_167 (air+aerosol)	pg/m3
685	PCB_170 (air+aerosol)	pg/m3
686	PCB_180 (air+aerosol)	pg/m3
689	PCB_183 (air+aerosol)	pg/m3

690	PCB_187 (air+aerosol)	pg/m3
691	PCB_189 (air+aerosol)	pg/m3
692	PCB_194 (air+aerosol)	pg/m3
695	PCB_28 (air+aerosol)	pg/m3
701	PCB_52 (air+aerosol)	pg/m3
706	PCB_74 (air+aerosol)	pg/m3
707	PCB_99 (air+aerosol)	pg/m3
709	PCB_123 (air+aerosol)	pg/m3
712	phenanthrene (air+aerosol)	ng/m3
714	phenanthrene (precip+dry_dep)	µg/m2/day
715	pyrene (air+aerosol)	ng/m3
717	pyrene (precip+dry_dep)	µg/m2/day
719	sulphate (precip)	mg S/l
753	precipitation_amount (precip)	mm
754	precipitation_amount_off (precip)	mm
760	Benzo(j)fluoranthene (precip+dry_dep)	µg/m2/day
762	Benzo(j)fluoranthene (air+aerosol)	ng/m3
763	Dibenzo(ah)anthracene (air+aerosol)	ng/m3
1012	Lead in PM2.5 (aerosol)	µg/m3
1029	Benzo(a)pyrene in PM2.5 (aerosol)	ng/m3
1045	Ammonium in PM2.5 (aerosol)	µg/m3
1046	Nitrate in PM2.5 (aerosol)	µg/m3
1047	sulphate in PM2.5 (aerosol)	µg/m3
1629	calcium in PM2.5 (aerosol)	µg/m3
1631	chloride in PM2.5 (aerosol)	µg/m3
1657	potassium in PM2.5 (aerosol)	µg/m3
1659	magnesium in PM2.5 (aerosol)	µg/m3
1668	sodium in PM2.5 (aerosol)	µg/m3
1771	Elemental carbon in PM2.5 (aerosol)	µg/m3
1772	Organic carbon in PM2.5 (aerosol)	µg/m3
2012	Lead (precip)	µg/l
2013	Mercury (precip)	ng/l
2014	Cadmium (precip)	µg/l
2015	Nickel (precip)	µg/l
2018	Arsenic (precip)	µg/l
2063	Zinc (precip)	µg/l
2065	Iron (precip)	µg/l
2073	Copper (precip)	µg/l
2076	acidity(pH) (precip)	pH units
4013	Mercury (air+aerosol)	ng/m3
4330	PCB_105 (air+aerosol)	pg/m3
4336	PCB_149 (air+aerosol)	pg/m3
4339	PCB_156 (air+aerosol)	pg/m3

4341	PCB_18 (air+aerosol)	pg/m3
4347	PCB_31 (air+aerosol)	pg/m3
4406	chrysene (air+aerosol)	ng/m3
4813	Total gaseous mercury (air+aerosol)	ng/m3
5012	Lead in PM10 (aerosol)	µg/m3
5013	Mercury in PM10 (aerosol)	ng/m3
5014	Cadmium in PM10 (aerosol)	ng/m3
5015	Nickel in PM10 (aerosol)	ng/m3
5018	Arsenic in PM10 (aerosol)	ng/m3
5029	Benzo(a)pyrene in PM10 (aerosol)	ng/m3
5045	Ammonium in PM10 (aerosol)	µg/m3
5046	Nitrate in PM10 (aerosol)	µg/m3
5129	Benzo(a)pyrene in PM10 (air+aerosol)	ng/m3
5380	Benzo(b,j,k)fluoranthene in PM10 (aerosol)	ng/m3
5419	Dibenzo(ah)anthracene in PM10 (aerosol)	ng/m3
5609	Benzo(a)anthracene in PM10 (air+aerosol)	ng/m3
5610	Benzo(a)anthracene in PM10 (aerosol)	ng/m3
5616	Benzo(b)fluoranthene in PM10 (air+aerosol)	ng/m3
5617	Benzo(b)fluoranthene in PM10 (aerosol)	ng/m3
5625	Benzo(k)fluoranthene in PM10 (air+aerosol)	ng/m3
5626	Benzo(k)fluoranthene in PM10 (aerosol)	ng/m3
5654	indeno_123cd_pyrene in PM10 (air+aerosol)	ng/m3
5655	indeno_123cd_pyrene in PM10 (aerosol)	ng/m3
5657	potassium in PM10 (aerosol)	µg/m3
5759	Benzo(j)fluoranthene in PM10 (aerosol)	ng/m3
5762	Benzo(j)fluoranthene in PM10 (air+aerosol)	ng/m3
5763	Dibenzo(ah)anthracene in PM10 (air+aerosol)	ng/m3
6001	Particulate matter < 2.5 Âµm (aerosol)	µg/m3
6002	Particulate matter < 1 Âµm (aerosol)	µg/m3
6005	1-Butene (air)	µg/m3
6006	trans-2-Butene (air)	µg/m3
6007	cis-2-Butene (air)	µg/m3
6008	1-Pentene (air)	µg/m3
6009	2-Pentenes (air)	µg/m3
6011	1,2,4-Trimethylbenzene (air)	µg/m3
6012	1,2,3-Trimethylbenzene (air)	µg/m3
6013	1,3,5-Trimethylbenzene (air)	µg/m3
6015	Benzo(a)pyrene (air+aerosol)	ng/m3
6380	Benzo(b,j,k)fluoranthene in PM10 (air+aerosol)	ng/m3
7012	Lead (precip+dry_dep)	µg/m2/day
7013	Mercury (precip+dry_dep)	µg/m2/day
7014	Cadmium (precip+dry_dep)	µg/m2/day
7015	Nickel (precip+dry_dep)	µg/m2/day

7018	Arsenic (precip+dry_dep)	µg/m2/day
7029	Benzo(a)pyrene (precip+dry_dep)	ng/m2/day
7380	Benzo(b,j,k)fluoranthene (precip+dry_dep)	µg/m2/day
7419	Dibenzo(ah)anthracene (precip+dry_dep)	ng/m2/day

Table 12: List of EMEP monitoring stations that were in operation in the year 2010. Information obtained from http://www.nilu.no/projects/ccc/network/index.html. While these stations are not located in the eight CITI-SENSE study sites, their data can provide valuable information on rural background conditions in the vicinity of the sites. This is also helpful for establishing boundary conditions for regional AQ models. The ordering is based alphabetically on the station code, whose first two letters indicate the ISO code of the country the station is located in.

Code	Station name	Latitude	Longitude	Elevation
AM0001R	Amberd	40.384	44.261	2080
AT0002R	Illmitz	47.767	16.767	117
AT0003R	Achenkirch	47.550	11.717	960
AT0004R	St. Koloman	47.650	13.200	851
AT0005R	Vorhegg	46.678	12.972	1020
AT0030R	Pillersdorf bei Retz	48.721	15.942	315
AT0032R	Sulzberg	47.529	9.927	1020
AT0033R	Stolzalpe bei Murau	47.129	14.204	1302
AT0034G	Sonnblick	47.054	12.958	3106
AT0037R	Zillertaler Alpen	47.137	11.870	1970
AT0038R	Gerlitzen	46.694	13.915	1895
AT0040R	Masenberg	47.348	15.882	1170
AT0041R	Haunsberg	47.973	13.016	730
AT0042R	Heidenreichstein	48.879	15.047	570
AT0043R	Forsthof	48.106	15.919	581
AT0044R	Graz Platte	47.113	15.471	651
AT0045R	Dunkelsteinerwald	48.371	15.547	320
AT0046R	Gänserndorf	48.335	16.731	161
AT0047R	Stixneusiedl	48.051	16.677	240
AT0048R	Zoebelboden	47.839	14.441	899
AT0049R	Grebenzen bei St. Lamprecht	47.040	14.330	1648
BA0006R	Ivan Sedlo	43.767	18.033	970
BE0001R	Offagne	49.878	5.204	430
BE0005R	University of Gent	51.050	3.717	0
BE0014R	Koksijde	51.466	3.300	4
BE0032R	Eupen	51.458	6.003	295
BE0035R	Vezin	50.503	4.989	160
BG0001R	BEO Moussala	42.167	23.583	2971
BG0053R	Rojen peak	41.696	24.739	1750
BY0004R	Vysokoe	52.333	23.433	163

CH0001G	Jungfraujoch	46.548	7.985	3578
CH0002R	Payerne	46.813	6.945	489
CH0003R	Tänikon	47.480	8.905	539
CH0004R	Chaumont	47.050	6.979	1137
CH0005R	Rigi	47.068	8.464	1031
CH0031R	Sion	46.220	7.342	483
CY0002R	Ayia Marina	35.039	33.058	532
CZ0001R	Svratouch	49.733	16.050	737
CZ0003R	Kosetice	49.583	15.083	534
CZ0099R	Libus	50.150	15.067	0
DE0001R	Westerland	54.926	8.310	12
DE0002R	Waldhof	52.802	10.759	74
DE0003R	Schauinsland	47.915	7.909	1205
DE0004R	Deuselbach	49.765	7.052	480
DE0005R	Brotjacklriegel	48.819	13.219	1016
DE0006R	Arkona	54.683	13.433	42
DE0007R	Neuglobsow	53.167	13.033	62
DE0008R	Schmücke	50.650	10.767	937
DE0009R	Zingst	54.433	12.733	1
DE0011R	Hohenwestedt	54.100	9.667	75
DE0012R	Bassum	52.850	8.700	52
DE0013R	Rodenberg	52.317	9.367	148
DE0014R	Meinerzhagen	51.117	7.633	510
DE0015R	Usingen	50.333	8.533	485
DE0016R	Bad Kreuznach	49.833	7.867	230
DE0017R	Ansbach	49.250	10.583	481
DE0018R	Rottenburg	48.483	8.933	427
DE0019R	Starnberg	48.017	11.350	729
DE0020R	Hof	50.317	11.883	568
DE0026R	Ueckermünde	53.750	14.067	1
DE0031R	Wiesenburg	52.117	12.467	107
DE0035R	Lückendorf	50.833	14.767	490
DE0038R	Murnauer Moos	47.651	11.203	622
DE0039R	Aukrug	54.075	9.793	15
DE0042R	Öhringen	49.243	9.447	283
DE0043G	Hohenpeissenberg	47.800	11.017	985
DE0044R	Melpitz	51.530	12.930	86

DE0045R	Schorfheide	52.967	13.650	70
DE0046R	Raisting	47.900	11.100	552
DE0047R	Falkenberg	52.167	14.117	73
DE0054R	Schneefernerhaus	47.417	10.982	2650
DE0056R	Bösel	52.998	7.943	40
DK0001R	Færøerne	62.030	-7.067	210
DK0003R	Tange	56.350	9.600	13
DK0005R	Keldsnor	54.733	10.733	10
DK0007R	Færøerne-Akraberg	61.400	-6.667	90
DK0008R	Anholt	56.717	11.517	40
DK0009R	Storebaelt	58.316	10.917	250
DK0012R	Risoe	55.693	12.086	3
DK0020R	Pedersker	55.017	14.946	5
DK0022R	Sepstrup Sande	55.083	9.600	60
DK0031R	Ulborg	56.283	8.433	10
DK0032R	Frederiksborg	55.967	12.333	10
DK0041R	Lille Valby	55.687	12.126	10
EE0002R	Syrve	57.950	22.100	2
EE0009R	Lahemaa	59.500	25.900	32
EE0011R	Vilsandi	58.383	21.817	6
ES0001R	San Pablo de los Montes	39.548	-4.349	917
ES0002R	La Cartuja	37.200	-3.600	720
ES0003R	Roquetas	40.821	-0.491	44
ES0004R	Logroño	42.458	-2.503	445
ES0005R	Noya	42.728	-8.924	683
ES0006R	Mahón	39.867	4.317	78
ES0007R	Víznar	37.233	-3.533	1265
ES0008R	Niembro	43.442	-4.850	134
ES0009R	Campisabalos	41.281	-3.143	1360
ES0010R	Cabo de Creus	42.319	3.317	23
ES0011R	Barcarrola	38.476	-6.923	393
ES0012R	Zarra	39.086	-1.102	885
ES0013R	Penausende	41.283	-5.867	985
ES0014R	Els Torms	41.400	-0.717	470
ES0015R	Risco Llamo	39.517	-4.350	1241
ES0016R	O Saviñao	43.231	-7.700	506
ES0017R	Doñana	37.030	-6.332	5

ES1778R	Montseny	41.767	2.350	700
FI0004R	Ähtäri	62.533	24.222	162
FI0006R	Kökar	59.917	20.917	10
FI0007R	Virolahti	60.517	27.683	8
FI0008R	Kevo	69.750	27.000	80
FI0009R	Utö	59.779	21.377	7
FI0017R	Virolahti II	60.527	27.686	4
FI0022R	Oulanka	66.320	29.402	310
FI0036R	Pallas (Matorova)	68.000	24.240	340
FI0037R	Ähtäri II	62.583	24.183	180
FI0050R	Hyytiälä	61.850	24.283	181
FI0053R	Hailuoto II	65.000	24.694	4
FI0090R	Haapasaari	60.283	27.200	15
FI0091R	Hailuoto	65.000	24.683	4
FI0092R	Hietajärvi	63.167	30.717	173
FI0093R	Kotinen	61.233	25.067	158
FI0094R	Pesosjärvi	66.300	29.500	257
FI0095R	Vuoskojärvi	69.733	26.950	147
FI0096G	Pallas (Sammaltunturi)	68.000	24.150	340
FR0001R	Vert-le-Petit	48.533	2.367	64
FR0003R	La Crouzille	46.133	1.383	497
FR0005R	La Hague	49.617	-1.833	133
FR0006R	Valduc	47.583	4.867	470
FR0007R	Lodeve	43.700	3.333	252
FR0008R	Donon	48.500	7.133	775
FR0009R	Revin	49.900	4.633	390
FR0010R	Morvan	47.267	4.083	620
FR0011R	Bonnevaux	46.817	6.183	836
FR0012R	Iraty	43.033	-1.083	1300
FR0013R	Peyrusse Vieille	43.617	-0.183	200
FR0014R	Montandon	47.300	6.833	836
FR0015R	La Tardière	46.650	-0.750	133
FR0016R	Le Casset	45.000	6.467	1750
FR0017R	Montfranc	45.800	2.067	810
FR0018R	La Coulonche	48.633	-0.450	309
FR0019R	Pic du Midi	42.937	-0.142	2877
FR0030R	Puy de Dôme	45.767	2.950	1465

FR0031R	Aubur	48.217	7.183	1135
FR0032R	Brennilis	48.350	-3.867	220
FR0090R	Porspoder	48.517	-4.750	50
GB0002R	Eskdalemuir	55.313	-3.204	243
GB0003R	Goonhilly	50.050	-5.183	108
GB0004R	Stoke Ferry	52.567	-0.500	15
GB0005R	Ludlow	52.367	-2.633	190
GB0006R	Lough Navar	54.443	-7.870	126
GB0007R	Barcombe Mills	50.867	-0.033	8
GB0013R	Yarner Wood	50.596	-3.713	119
GB0014R	High Muffles	54.334	-0.808	267
GB0015R	Strath Vaich Dam	57.734	-4.774	270
GB0016R	Glen Dye	56.968	-2.589	85
GB0017R	Heigham Holmes	52.717	1.617	0
GB0031R	Aston Hill	52.504	-3.033	370
GB0033R	Bush	55.859	-3.205	180
GB0035R	Great Dun Fell	54.683	-2.450	847
GB0036R	Harwell	51.573	-1.317	137
GB0037R	Ladybower Res.	53.399	-1.753	420
GB0038R	Lullington Heath	50.793	-0.179	120
GB0039R	Sibton	52.294	1.463	46
GB0041R	Wharley Croft	54.617	-2.467	26
GB0043R	Narberth	51.233	-4.700	160
GB0044R	Somerton	51.231	-3.048	55
GB0045R	Wicken Fen	52.298	-0.293	5
GB0046R	CEH Edingburgh	55.950	-3.217	0
GB0048R	Auchencorth Moss	55.793	-3.245	260
GB0049R	Weybourne	52.951	1.122	16
GB0050R	St. Osyth	51.778	1.082	8
GB0051R	Market Harborough	52.554	-0.772	145
GB0052R	Lerwick	60.139	-1.185	85
GB0053R	Charlton Mackrell	51.056	-2.683	54
GB0054R	Glen Saugh	56.907	-2.559	85
GB0090R	East Ruston	52.800	1.467	5
GB0091R	Banchory	57.077	-2.534	120
GB0092R	Chillerton	50.700	-1.300	35
GB0093R	Staxton Wold	54.183	-0.433	35

GB0094R	Lough Erne	54.400	-8.050	35
GB0095R	Driby	53.233	-0.067	47
GB0096R	Chilton	51.567	-1.317	109
GE0001R	Abastumani	41.755	42.825	1650
GR0001R	Aliartos	38.367	23.083	110
GR0002R	Finokalia	35.317	25.667	250
GR0003R	Livadi	40.533	23.250	850
HR0002R	Puntijarka	45.900	15.967	988
HR0004R	Zavizan	44.817	14.983	1594
HU0001R	Kecskemét	46.967	19.583	125
HU0002R	K-puszta	46.967	19.583	125
IE0001R	Valentia Observatory	51.940	-10.244	11
IE0002R	Turlough Hill	53.037	-6.400	420
IE0003R	The Burren	53.000	-9.100	90
IE0004R	Ridge of Capard	53.117	-7.450	340
IE0005R	Oak Park	52.869	-6.925	59
IE0006R	Malin Head	55.375	-7.343	20
IE0007R	Glenveagh	55.052	-7.940	44
IE0008R	Carnsore Point	52.185	-6.368	9
IE0009R	Johnstown Castle	52.299	-6.511	62
IE0031R	Mace Head	53.167	-9.500	15
IS0001R	Rjupnahed	64.083	-21.850	120
IS0002R	Irafoss	64.083	-21.017	66
IS0090R	Reykjavik	64.133	-21.900	52
IS0091R	Storhofdi	63.400	-20.283	118
IT0001R	Montelibretti	42.100	12.633	48
IT0002R	Stelvio	46.350	10.383	1415
IT0003R	Vallombrosa	43.733	11.550	1000
IT0004R	Ispra	45.800	8.633	209
IT0005R	Arabba	46.517	11.883	2030
IT0008R	ISAC Belogna	44.483	11.333	0
IT0009R	Mt Cimone	44.183	10.700	2165
KZ0001R	Borovoe	53.117	70.283	0
LT0003R	Nida	55.350	21.067	17
LT0015R	Preila	55.350	21.067	5
LV0010R	Rucava	56.162	21.173	18
LV0016R	Zoseni	57.135	25.906	188

LV0025R	Kemeri	56.917	23.467	0
MD0012R	Leova	46.500	28.267	156
MD0013R	Leova II	46.488	28.283	166
ME0008R	Zabljak	43.150	19.133	1450
MK0007R	Lazaropole	41.320	20.420	1332
MT0001R	Giordan lighthouse	36.100	14.200	160
NL0002R	Witteveen	52.817	6.667	18
NL0005R	Rekken	52.100	6.717	25
NL0006R	Appelscha	52.950	6.300	10
NL0007R	Eibergen	52.083	6.567	20
NL0008R	Bilthoven	52.117	5.200	5
NL0009R	Kollumerwaard	53.334	6.277	1
NL0010R	Vredepeel	51.541	5.854	28
NL0011R	Cabauw	51.970	4.930	60
NL0091R	De Zilk	52.300	4.500	4
NO0001R	Birkenes	58.383	8.250	190
NO0002R	Birkenes II	58.388	8.252	219
NO0008R	Skreådalen	58.817	6.717	475
NO0015R	Tustervatn	65.833	13.917	439
NO0030R	Jergul	69.450	24.600	255
NO0035R	Narbuvoll	62.350	11.667	768
NO0036R	Hummelfjell	62.450	11.267	1539
NO0037R	Bjørnøya	74.517	19.017	20
NO0039R	Kårvatn	62.783	8.883	210
NO0041R	Osen	61.250	11.783	440
NO0042G	Spitsbergen, Zeppelinfjell	78.900	11.883	474
NO0043R	Prestebakke	59.000	11.533	160
NO0044R	Nordmoen	60.267	11.100	200
NO0045R	Jeløya	59.433	10.600	5
NO0047R	Svanvik	69.450	30.033	30
NO0048R	Voss	60.600	6.533	500
NO0052R	Sandve	59.200	5.200	15
NO0055R	Karasjok	69.467	25.217	333
NO0056R	Hurdal	60.372	11.078	300
NO0090R	Andøya	69.278	16.012	380
NO0092R	Øverbygd	69.050	19.367	90
NO0093R	Valdalen	62.083	12.167	800

NO0094R	Møsvatn	59.833	8.333	940
NO0095R	Ualand	58.517	6.383	220
NO0097R	Solhomfjell	58.933	8.800	260
NO0098R	Karpdalen	69.650	30.433	70
NO0099R	Lista	58.100	6.567	13
PL0001R	Suwalki	54.133	22.950	184
PL0002R	Jarczew	51.817	21.983	180
PL0003R	Sniezka	50.733	15.733	1603
PL0004R	Leba	54.750	17.533	2
PL0005R	Diabla Gora	54.150	22.067	157
PT0001R	Braganca	41.817	-6.767	690
PT0002R	Faro	37.017	-7.967	8
PT0003R	Viana do Castelo	41.700	-8.800	16
PT0004R	Monte Velho	38.083	-8.800	43
PT0005R	Foia	37.317	-8.900	902
PT0010R	Angra do Heroismo	38.667	-27.217	74
RO0001R	Rarau	47.450	25.450	1536
RO0002R	Stina de Vale	46.683	23.533	1111
RO0003R	Semenic	45.117	25.967	1432
RO0004R	Paring	45.383	23.467	1585
RO0005R	Fundata	45.467	25.300	1371
RO0006R	Turia	46.117	25.983	1008
RO0008R	Poiana Stampei	47.325	25.134	908
RS0005R	Kamenicki vis	43.400	21.950	813
RU0001R	Janiskoski	68.933	28.850	118
RU0008R	Lesogorsky	61.000	28.967	39
RU0013R	Pinega	64.700	43.400	28
RU0014R	Pushkinskie Gory	57.000	28.900	103
RU0016R	Shepeljovo	59.967	29.117	4
RU0018R	Danki	54.900	37.800	150
RU0020R	Lesnoy	56.530	32.940	340
SE0001R	Ekeröd	55.900	13.717	140
SE0002R	Rörvik	57.417	11.933	10
SE0003R	Velen	58.783	14.300	127
SE0005R	Bredkälen	63.850	15.333	404
SE0008R	Hoburgen	56.917	18.150	58
SE0011R	Vavihill	56.017	13.150	175

SE0012R	Aspvreten	58.800	17.383	20
SE0013R	Esrange	67.883	21.067	475
SE0014R	Råö	57.394	11.914	5
SE0031R	Ammarnäs	65.967	16.200	480
SE0032R	Norra-Kvill	57.817	15.567	261
SE0033R	Sännen	56.333	15.333	90
SE0034R	Storulvsjöen	62.267	16.300	420
SE0035R	Vindeln	64.250	19.767	225
SE0039R	Grimsö	59.728	15.472	132
SE0051R	Arup	55.750	13.667	157
SE0094R	Ammarnäs	65.967	16.200	140
SE0097R	Gårdsjön	58.050	12.017	126
SI0001R	Masun	45.650	14.367	1026
SI0008R	Iskrba	45.567	14.867	520
SI0031R	Zarodnje	46.429	15.003	770
SI0032R	Krvavec	46.299	14.539	1740
SI0033R	Kovk	46.129	15.114	600
SK0002R	Chopok	48.933	19.583	2008
SK0004R	Stará Lesná	49.150	20.283	808
SK0005R	Liesek	49.367	19.683	892
SK0006R	Starina	49.050	22.267	345
SK0007R	Topolniky	47.960	17.861	113
TR0001R	Cubuk II	40.500	33.000	1169
UA0005R	Svityaz	51.517	23.883	164
UA0006R	Rava-Russkaya	50.250	23.633	249
UA0007R	Beregovo	48.250	22.683	112

Table 13: Overview of MACC-II products and services (produced by R. Engelen, ECMWF). The table is based on the Product Catalogue that is available through the MACC-II website (http://www.gmes-atmosphere.eu). All products are listed here for completeness, but in particular some of the regional European models that provide output at higher spatial resolution than the MACC-II global model, will be helpful for CITI-SENSE.

Product	Production type	Geographic area	Vertical coordinate	Time resolution	Physical parameter	Species	Service type
MACC-IFS NRT forecast of global total aerosol optical depth at multiple wavelengths	Forecast	Global	column	3-hourly	Aerosol	Total AOD	Air quality & atmospheric composition
MACC-IFS NRT forecast of global sulfate aerosol optical depth at 550 nm	Forecast	Global	column	3-hourly	Aerosol	Sulfate AOD	Air quality & atmospheric composition
MACC-IFS NRT forecast of global organic carbon aerosol optical depth at 550 nm	Forecast	Global	column	3-hourly	Aerosol	Organic carbon AOD	Air quality & atmospheric composition
MACC-IFS NRT forecast of global black carbon aerosol optical depth at 550 nm	Forecast	Global	column	3-hourly	Aerosol	Black carbon AOD	Air quality & atmospheric composition
MACC-IFS NRT forecast of global sea-salt aerosol optical depth at 550 nm	Forecast	Global	column	3-hourly	Aerosol	Sea-salt AOD	Air quality & atmospheric composition
MACC-IFS NRT forecast of global dust aerosol optical depth at 550 nm	Forecast	Global	column	3-hourly	Aerosol	Dust AOD	Air quality & atmospheric composition
MACC-IFS NRT forecast of global aerosol extinction coefficient at 550 nm	Forecast	Global	troposphere	3-hourly	Aerosol	Aerosol extinction coefficient	Air quality & atmospheric composition
MACC-IFS NRT forecast of global sulfates aerosol concentration	Forecast	Global	troposphere	3-hourly	Aerosol	Sulfates concentration	Air quality & atmospheric composition
MACC-IFS NRT forecast of global organic carbon aerosol concentration	Forecast	Global	troposphere	3-hourly	Aerosol	Organic carbon concentration	Air quality & atmospheric composition
MACC-IFS NRT forecast of global black carbon aerosol concentration	Forecast	Global	troposphere	3-hourly	Aerosol	Black carbon concentration	Air quality & atmospheric composition
MACC-IFS NRT forecast of global sea-salt aerosol concentration (3 bins)	Forecast	Global	troposphere	3-hourly	Aerosol	Sea-salt concentration (3 bins)	Air quality & atmospheric composition
MACC-IFS NRT forecast of global dust aerosol concentration (3 bins)	Forecast	Global	troposphere	3-hourly	Aerosol	Dust concentration	Air quality & atmospheric composition
MACC-IFS NRT forecast of global PM10	Forecast	Global	troposphere	3-hourly	Aerosol	PM10	Air quality & atmospheric composition
MACC-IFS NRT forecast of global PM2.5	Forecast	Global	troposphere	3-hourly	Aerosol	PM2.5	Air quality & atmospheric composition
MACC-IFS reanalysis of global total aerosol optical depth at multiple wavelengths	Reanalysis	Global	column	3-hourly	Aerosol	Total AOD	Air quality & atmospheric composition
MACC-IFS reanalysis of global sulfate aerosol optical depth at 550 nm	Reanalysis	Global	column	3-hourly	Aerosol	Sulfate AOD	Air quality & atmospheric composition
MACC-IFS reanalysis of global organic carbon aerosol optical depth at 550 nm	Reanalysis	Global	column	3-hourly	Aerosol	Organic carbon AOD	Air quality & atmospheric composition
MACC-IFS reanalysis of global black carbon aerosol optical depth at 550 nm	Reanalysis	Global	column	3-hourly	Aerosol	Black carbon AOD	Air quality & atmospheric composition
MACC-IFS reanalysis of global sea-salt aerosol optical depth at 550 nm	Reanalysis	Global	column	3-hourly	Aerosol	Sea-salt AOD	Air quality & atmospheric composition
MACC-IFS reanalysis of global dust aerosol optical depth at 550 nm	Reanalysis	Global	column	3-hourly	Aerosol	Dust AOD	Air quality & atmospheric composition
MACC-IFS reanalysis of global aerosol extinction coefficient at 550 nm	Reanalysis	Global	troposphere	3-hourly	Aerosol	Aerosol extinction coefficient	Air quality & atmospheric composition

MACC-IFS reanalysis of global sulfates aerosol concentration	Reanalysis	Global	troposphere	3-hourly	Aerosol	Sulfates concentration	Air quality & atmospheric composition
MACC-IFS reanalysis of global organic carbon aerosol concentration	Reanalysis	Global	troposphere	3-hourly	Aerosol	Organic carbon concentration	Air quality & atmospheric composition
MACC-IFS reanalysis of global black carbon aerosol concentration	Reanalysis	Global	troposphere	3-hourly	Aerosol	Black carbon concentration	Air quality & atmospheric composition
MACC-IFS reanalysis of global sea-salt aerosol concentration (3 bins)	Reanalysis	Global	troposphere	3-hourly	Aerosol	Sea-salt concentration (3 bins)	Air quality & atmospheric composition
MACC-IFS reanalysis of global dust aerosol concentration (3 bins)	Reanalysis	Global	troposphere	3-hourly	Aerosol	Dust concentration	Air quality & atmospheric composition
MACC-IFS reanalysis of global PM10	Reanalysis	Global	troposphere	3-hourly	Aerosol	PM10	Air quality & atmospheric composition
MACC-IFS reanalysis of global PM2.5	Reanalysis	Global	troposphere	3-hourly	Aerosol	PM2.5	Air quality & atmospheric composition
MACC-IFS-MOZ NRT analyses of global ozone	Analysis	Global	0..80 km	3-hourly, Monthly	Reactive gas, Greenhouse gas	O3	Air quality & atmospheric composition, Ozone & Ultraviolet radiation
MACC-IFS-MOZ NRT analyses of global carbon monoxide	Analysis	Global	0..80 km	3-hourly, Monthly	Reactive gas	CO	Air quality & atmospheric composition
MACC-IFS-MOZ NRT analyses of global reactive nitrogen oxides	Analysis	Global	0..80 km	3-hourly, Monthly	Reactive gas	NOx	Air quality & atmospheric composition
MACC-IFS-MOZ NRT analyses and forecasts of global nitric acid	Analysis	Global	0..80 km	3-hourly, Monthly	Reactive gas	HNO3	Air quality & atmospheric composition, Ozone & Ultraviolet radiation
MACC-IFS-MOZ NRT analyses of global formaldehyde	Analysis	Global	0..80 km	3-hourly, Monthly	Reactive gas	HCHO	Air quality & atmospheric composition
MACC-IFS-MOZ NRT analyses of global sulphur dioxide	Analysis	Global	0..80 km	3-hourly, Monthly	Reactive gas	SO2	Air quality & atmospheric composition
MACC-IFS-MOZ NRT analyses of global BrO	Analysis	Global	0..80 km	3-hourly, Monthly	Reactive gas	BrO	Air quality & atmospheric composition
MACC-IFS-MOZ NRT forecasts of global ozone	Forecast	Global	0..80 km	3-hourly, Monthly	Reactive gas, Greenhouse gas	O3	Air quality & atmospheric composition, Ozone & Ultraviolet radiation
MACC-IFS-MOZ NRT forecasts of global carbon monoxide	Forecast	Global	0..80 km	3-hourly, Monthly	Reactive gas	CO	Air quality & atmospheric composition
MACC-IFS-MOZ NRT forecasts of global reactive nitrogen oxides	Forecast	Global	0..80 km	3-hourly, Monthly	Reactive gas	NOx	Air quality & atmospheric composition
MACC-IFS-MOZ NRT forecasts of global nitric acid	Forecast	Global	0..80 km	3-hourly, Monthly	Reactive gas	HNO3	Air quality & atmospheric composition, Ozone & Ultraviolet radiation
MACC-IFS-MOZ NRT forecasts of global formaldehyde	Forecast	Global	0..80 km	3-hourly, Monthly	Reactive gas	HCHO	Air quality & atmospheric composition
MACC-IFS-MOZ NRT forecasts of global sulphur dioxide	Forecast	Global	0..80 km	3-hourly, Monthly	Reactive gas	SO2	Air quality & atmospheric composition
MACC-IFS-MOZ NRT forecasts of global BrO	Forecast	Global	0..80 km	3-hourly, Monthly	Reactive gas	BrO	Ozone & Ultraviolet radiation
MACC-IFS-MOZ reanalysis of global ozone	Reanalysis	Global	0..80 km	3-hourly, Monthly	Reactive gas, Greenhouse gas	O3	Air quality & atmospheric composition, Ozone & Ultraviolet radiation
MACC-IFS-MOZ reanalysis of global carbon monoxide	Reanalysis	Global	0..80 km	3-hourly, Monthly	Reactive gas	CO	Air quality & atmospheric composition
MACC-IFS-MOZ reanalysis of global reactive nitrogen oxides	Reanalysis	Global	0..80 km	3-hourly, Monthly	Reactive gas	NOx	Air quality & atmospheric composition
MACC-IFS-MOZ reanalysis of global nitric acid	Reanalysis	Global	0..80 km	3-hourly, Monthly	Reactive gas	HNO3	Air quality & atmospheric composition, Ozone & Ultraviolet radiation
MACC-IFS-MOZ reanalysis of global formaldehyde	Reanalysis	Global	0..80 km	3-hourly, Monthly	Reactive gas	HCHO	Air quality & atmospheric composition
MACC-IFS-MOZ reanalysis of global sulphur dioxifde	Reanalysis	Global	0..80 km	3-hourly, Monthly	Reactive gas	SO2	Air quality & atmospheric composition
MACC-IFS-MOZ reanalysis of global BrO	Reanalysis	Global	0..80 km	3-hourly, Monthly	Reactive gas	BrO	Ozone & Ultraviolet radiation
European-scale ensemble hourly AQ analyses of ozone of the previous day	Analysis	Europe		Hourly	Reactive gas	O3	Air quality & atmospheric composition
European-scale ensemble hourly AQ forecast of ozone up to 72h ahead	Forecast	Europe		Hourly	Reactive gas	O3	Air quality & atmospheric composition

European-scale ensemble hourly AQ analyses of nitrogen oxides of the previous day	Analysis	Europe	Hourly	Reactive gas	NOx	Air quality & atmospheric composition
European-scale ensemble hourly AQ forecast of nitrogen oxides up to 72h ahead	Forecast	Europe	Hourly	Reactive gas	NOx	Air quality & atmospheric composition
European-scale ensemble hourly AQ analyses of sulphur dioxide of the previous day	Analysis	Europe	Hourly	Reactive gas	SO2	Air quality & atmospheric composition
European-scale ensemble hourly AQ forecast of sulphur dioxide up to 72h ahead	Forecast	Europe	Hourly	Reactive gas	SO2	Air quality & atmospheric composition
European-scale ensemble hourly AQ analyses of carbon monoxide of the previous day	Analysis	Europe	Hourly	Reactive gas	CO	Air quality & atmospheric composition
European-scale ensemble hourly AQ forecast of carbon monoxide up to 72h ahead	Forecast	Europe	Hourly	Reactive gas	CO	Air quality & atmospheric composition
European-scale ensemble hourly AQ analyses of PM10 of the previous day	Analysis	Europe	Hourly	Aerosol	PM10	Air quality & atmospheric composition
European-scale ensemble hourly AQ forecast of PM10 up to 72h ahead	Forecast	Europe	Hourly	Aerosol	PM10	Air quality & atmospheric composition
Source-receptor calculations for ozone air pollution episodes in forecast mode (72 hours ahead)	Forecast	Europe	Hourly	Reactive gas	O3	Air quality & atmospheric composition
Source-receptor calculations for PM10 air pollution episodes in forecast mode (72 hours ahead)	Forecast	Europe	Hourly	Aerosol	PM10	Air quality & atmospheric composition
European-scale AQ ozone forecast by CHIMERE	Forecast	Europe	Hourly	Reactive gas	O3	Air quality & atmospheric composition
European-scale AQ nitrogen dioxide forecast by CHIMERE	Forecast	Europe	Hourly	Reactive gas	NO2	Air quality & atmospheric composition
European-scale AQ sulphur dioxide forecast by CHIMERE	Forecast	Europe	Hourly	Reactive gas	SO2	Air quality & atmospheric composition
European-scale AQ carbon monoxide forecast by CHIMERE	Forecast	Europe	Hourly	Reactive gas	CO	Air quality & atmospheric composition
European-scale AQ PM10 forecast by CHIMERE	Forecast	Europe	Hourly	Aerosol	PM10	Air quality & atmospheric composition
European-scale AQ ozone analysis by CHIMERE	Analysis	Europe	Hourly	Reactive gas	O3	Air quality & atmospheric composition
European-scale AQ nitrogen dioxide analysis by CHIMERE	Analysis	Europe	Hourly	Reactive gas	NO2	Air quality & atmospheric composition
European-scale AQ sulphur dioxide analysis by CHIMERE	Analysis	Europe	Hourly	Reactive gas	SO2	Air quality & atmospheric composition
European-scale AQ carbon monoxide analysis by CHIMERE	Analysis	Europe	Hourly	Reactive gas	CO	Air quality & atmospheric composition
European-scale AQ PM10 analysis by CHIMERE	Analysis	Europe	Hourly	Aerosol	PM10	Air quality & atmospheric composition
European-scale AQ ozone forecast by EMEP	Forecast	Europe	Hourly	Reactive gas	O3	Air quality & atmospheric composition
European-scale AQ nitrogen dioxide forecast by EMEP	Forecast	Europe	Hourly	Reactive gas	NO2	Air quality & atmospheric composition
European-scale AQ sulphur dioxide forecast by EMEP	Forecast	Europe	Hourly	Reactive gas	SO2	Air quality & atmospheric composition
European-scale AQ carbon monoxide forecast by EMEP	Forecast	Europe	Hourly	Reactive gas	CO	Air quality & atmospheric composition
European-scale AQ PM10 forecast by EMEP	Forecast	Europe	Hourly	Aerosol	PM10	Air quality & atmospheric composition
European-scale AQ ozone analysis by EMEP	Analysis	Europe	Hourly	Reactive gas	O3	Air quality & atmospheric composition
European-scale AQ nitrogen dioxide analysis by EMEP	Analysis	Europe	Hourly	Reactive gas	NO2	Air quality & atmospheric composition
European-scale AQ sulphur dioxide analysis by EMEP	Analysis	Europe	Hourly	Reactive gas	SO2	Air quality & atmospheric composition
European-scale AQ carbon monoxide analysis by EMEP	Analysis	Europe	Hourly	Reactive gas	CO	Air quality & atmospheric composition
European-scale AQ PM10 analysis by EMEP	Analysis	Europe	Hourly	Aerosol	PM10	Air quality & atmospheric composition
European-scale AQ ozone forecast by EURAD	Forecast	Europe	Hourly	Reactive gas	O3	Air quality & atmospheric composition
European-scale AQ nitrogen dioxide forecast by EURAD	Forecast	Europe	Hourly	Reactive gas	NO2	Air quality & atmospheric composition

European-scale AQ sulphur dioxide forecast by EURAD	Forecast	Europe	Hourly	Reactive gas	SO2	Air quality & atmospheric composition
European-scale AQ carbon monoxide forecast by EURAD	Forecast	Europe	Hourly	Reactive gas	CO	Air quality & atmospheric composition
European-scale AQ PM10 forecast by EURAD	Forecast	Europe	Hourly	Aerosol	PM10	Air quality & atmospheric composition
European-scale AQ ozone analysis by EURAD	Analysis	Europe	Hourly	Reactive gas	O3	Air quality & atmospheric composition
European-scale AQ nitrogen dioxide analysis by EURAD	Analysis	Europe	Hourly	Reactive gas	NO2	Air quality & atmospheric composition
European-scale AQ sulphur dioxide analysis by EURAD	Analysis	Europe	Hourly	Reactive gas	SO2	Air quality & atmospheric composition
European-scale AQ carbon monoxide analysis by EURAD	Analysis	Europe	Hourly	Reactive gas	CO	Air quality & atmospheric composition
European-scale AQ PM10 analysis by EURAD	Analysis	Europe	Hourly	Aerosol	PM10	Air quality & atmospheric composition
European-scale AQ ozone forecast by LOTOS-EUROS	Forecast	Europe	Hourly	Reactive gas	O3	Air quality & atmospheric composition
European-scale AQ nitrogen dioxide forecast by LOTOS-EUROS	Forecast	Europe	Hourly	Reactive gas	NO2	Air quality & atmospheric composition
European-scale AQ sulphur dioxide forecast by LOTOS-EUROS	Forecast	Europe	Hourly	Reactive gas	SO2	Air quality & atmospheric composition
European-scale AQ carbon monoxide forecast by LOTOS-EUROS	Forecast	Europe	Hourly	Reactive gas	CO	Air quality & atmospheric composition
European-scale AQ PM10 forecast by LOTOS-EUROS	Forecast	Europe	Hourly	Aerosol	PM10	Air quality & atmospheric composition
European-scale AQ ozone analysis by LOTOS-EUROS	Analysis	Europe	Hourly	Reactive gas	O3	Air quality & atmospheric composition
European-scale AQ nitrogen dioxide analysis by LOTOS-EUROS	Analysis	Europe	Hourly	Reactive gas	NO2	Air quality & atmospheric composition
European-scale AQ sulphur dioxide analysis by LOTOS-EUROS	Analysis	Europe	Hourly	Reactive gas	SO2	Air quality & atmospheric composition
European-scale AQ carbon monoxide analysis by LOTOS-EUROS	Analysis	Europe	Hourly	Reactive gas	CO	Air quality & atmospheric composition
European-scale AQ PM10 analysis by LOTOS-EUROS	Analysis	Europe	Hourly	Aerosol	PM10	Air quality & atmospheric composition
European-scale AQ ozone forecast by MATCH	Forecast	Europe	Hourly	Reactive gas	O3	Air quality & atmospheric composition
European-scale AQ nitrogen dioxide forecast by MATCH	Forecast	Europe	Hourly	Reactive gas	NO2	Air quality & atmospheric composition
European-scale AQ sulphur dioxide forecast by MATCH	Forecast	Europe	Hourly	Reactive gas	SO2	Air quality & atmospheric composition
European-scale AQ carbon monoxide forecast by MATCH	Forecast	Europe	Hourly	Reactive gas	CO	Air quality & atmospheric composition
European-scale AQ PM10 forecast by MATCH	Forecast	Europe	Hourly	Aerosol	PM10	Air quality & atmospheric composition
European-scale AQ ozone analysis by MATCH	Analysis	Europe	Hourly	Reactive gas	O3	Air quality & atmospheric composition
European-scale AQ nitrogen dioxide analysis by MATCH	Analysis	Europe	Hourly	Reactive gas	NO2	Air quality & atmospheric composition
European-scale AQ sulphur dioxide analysis by MATCH	Analysis	Europe	Hourly	Reactive gas	SO2	Air quality & atmospheric composition
European-scale AQ carbon monoxide analysis by MATCH	Analysis	Europe	Hourly	Reactive gas	CO	Air quality & atmospheric composition
European-scale AQ PM10 analysis by MATCH	Analysis	Europe	Hourly	Aerosol	PM10	Air quality & atmospheric composition
European-scale AQ ozone forecast by MOCAGE	Forecast	Europe	Hourly	Reactive gas	O3	Air quality & atmospheric composition
European-scale AQ nitrogen dioxide forecast by MOCAGE	Forecast	Europe	Hourly	Reactive gas	NO2	Air quality & atmospheric composition
European-scale AQ sulphur dioxide forecast by MOCAGE	Forecast	Europe	Hourly	Reactive gas	SO2	Air quality & atmospheric composition
European-scale AQ carbon monoxide forecast by MOCAGE	Forecast	Europe	Hourly	Reactive gas	CO	Air quality & atmospheric composition
European-scale AQ PM10 forecast by MOCAGE	Forecast	Europe	Hourly	Aerosol	PM10	Air quality & atmospheric composition
European-scale AQ ozone analysis by MOCAGE	Analysis	Europe	Hourly	Reactive gas	O3	Air quality & atmospheric composition
European-scale AQ nitrogen dioxide analysis by MOCAGE	Analysis	Europe	Hourly	Reactive gas	NO2	Air quality & atmospheric composition

European-scale AQ sulphur dioxide analysis by MOCAGE	Analysis	Europe	Hourly	Reactive gas	SO2	Air quality & atmospheric composition
European-scale AQ carbon monoxide analysis by MOCAGE	Analysis	Europe	Hourly	Reactive gas	CO	Air quality & atmospheric composition
European-scale AQ PM10 analysis by MOCAGE	Analysis	Europe	Hourly	Aerosol	PM10	Air quality & atmospheric composition
European-scale AQ ozone forecast by SILAM	Forecast	Europe	Hourly	Reactive gas	O3	Air quality & atmospheric composition
European-scale AQ nitrogen dioxide forecast by SILAM	Forecast	Europe	Hourly	Reactive gas	NO2	Air quality & atmospheric composition
European-scale AQ sulphur dioxide forecast by SILAM	Forecast	Europe	Hourly	Reactive gas	SO2	Air quality & atmospheric composition
European-scale AQ carbon monoxide forecast by SILAM	Forecast	Europe	Hourly	Reactive gas	CO	Air quality & atmospheric composition
European-scale AQ PM10 forecast by SILAM	Forecast	Europe	Hourly	Aerosol	PM10	Air quality & atmospheric composition
European-scale AQ ozone analysis by SILAM	Analysis	Europe	Hourly	Reactive gas	O3	Air quality & atmospheric composition
European-scale AQ nitrogen dioxide analysis by SILAM	Analysis	Europe	Hourly	Reactive gas	NO2	Air quality & atmospheric composition
European-scale AQ sulphur dioxide analysis by SILAM	Analysis	Europe	Hourly	Reactive gas	SO2	Air quality & atmospheric composition
European-scale AQ carbon monoxide analysis by SILAM	Analysis	Europe	Hourly	Reactive gas	CO	Air quality & atmospheric composition
European-scale AQ PM10 analysis by SILAM	Analysis	Europe	Hourly	Aerosol	PM10	Air quality & atmospheric composition
MACC-UKMO NRT dust AOD forecast	Forecast	Europe, North Africa	3-hourly	Aerosol	Dust AOD	Air quality & atmospheric composition
MACC-UKMO NRT dust concentration forecast	Forecast	Europe, North Africa	3-hourly	Aerosol	Dust concentration	Air quality & atmospheric composition
MACC delayed mode aerosol direct forcing	Analysis	Global	Daily	Aerosol	Aerosol direct radiative forcing	Climate forcing
MACC delayed mode aerosol indirect forcing	Analysis	Global	Daily	Aerosol	Aerosol indirect radiative forcing	Climate forcing
MACC delayed mode SO2 aerosol sources	Surface fluxes	Global	Monthly	Aerosol	SO2 sources	Emissions & fluxes
MACC delayed mode organic carbon aerosol sources	Surface fluxes	Global	Monthly	Aerosol	Organic carbon sources	Emissions & fluxes
MACC delayed mode black carbon aerosol sources	Surface fluxes	Global	Monthly	Aerosol	Black carbon sources	Emissions & fluxes
MACC delayed mode biomass burning aerosol sources	Surface fluxes	Global	Monthly	Aerosol	Biomass burning aerosol sources	Emissions & fluxes
MACC delayed mode sea-salt aerosol sources	Surface fluxes	Global	Monthly	Aerosol	Sea-salt sources	Emissions & fluxes
MACC delayed mode dust aerosol sources	Surface fluxes	Global	Monthly	Aerosol	Dust sources	Emissions & fluxes
SYNAER NRT aerosol optical depth	Observations	Europe	Daily	Aerosol	Total AOD	Air quality & atmospheric composition
SYNAER record aerosol optical depth	Observations	MSG FOD	Daily	Aerosol	Total AOD	Air quality & atmospheric composition
ATSR-DV global aerosol	Observations	Global	Daily	Aerosol	Total AOD	Air quality & atmospheric composition
SEVIRI NRT aerosol optical depth over ocean	Observations	MSG FOV	30 minutes	Aerosol	Total AOD	Air quality & atmospheric composition
SEVIRI NRT aerosol optical depth over land	Observations	MSG FOV	30 minutes	Aerosol	Total AOD	Air quality & atmospheric composition
CALIPSO NRT aerosol backscatter	Observations	Global	Daily	Aerosol	Aerosol backscatter	Air quality & atmospheric composition
IASI dust aerosol optical depth monthly averages	Observations	Africa, Atlantic Ocean	Monthly	Aerosol	Dust AOD	Air quality & atmospheric composition
IASI dust altitude monthly averages	Observations	Africa, Atlantic Ocean	Monthly	Aerosol	Dust layer altitude	Air quality & atmospheric composition

IASI dust aerosol optical depth	Observations	Africa, Atlantic Ocean		Daily	Aerosol	Dust AOD	Air quality & atmospheric composition
Delayed-mode analyses of global aerosol	Analysis	Global		3-hourly	Aerosol	Dust AOD	Air quality & atmospheric composition
Global MACC reanalysis of dust AOD over 2003-2010	Analysis	Global		3-hourly	Aerosol	Dust AOD	Air quality & atmospheric composition
Global MACC reanalysis of total AOD over 2003-2010	Analysis	Global		Climatology	Aerosol	Total AOD	Air quality & atmospheric composition, Solar radiation
Global MACC reanalysis of monthly averaged dust AOD over 2003-2010	Analysis	Global		Climatology	Aerosol	Dust AOD	Air quality & atmospheric composition, Solar radiation
MACC NRT aerosol verification	Observations	Global		Daily	Aerosol	Total AOD	Air quality & atmospheric composition
AEROCOM delayed-mode aerosol verification	Analysis	Global		Daily, Monthly	Aerosol	Total AOD	Air quality & atmospheric composition
Aerosol alert system	Forecast	Global		Daily	Aerosol	Aerosol	Air quality & atmospheric composition
C-IFS-CBM4 NRT analyses and forecasts of global ozone	Forecast	Global	0..80 km	3-hourly, Monthly	Reactive gas, Greenhouse gas	O3	Air quality & atmospheric composition, Ozone & Ultraviolet radiation, Climate forcing
BASCOE assimilated NRT global stratospheric ozone	Analysis	Global	15-80 km	3-hourly	Reactive gas, Greenhouse gas	O3	Ozone & Ultraviolet radiation
TM3DAM global total ozone monitoring	Analysis	Global	column	Daily, Monthly	Reactive gas, Greenhouse gas	O3	Ozone & Ultraviolet radiation
TM3DAM global total ozone forecast	Forecast	Global			Reactive gas, Greenhouse gas	O3	Ozone & Ultraviolet radiation
BASCOE assimilated NRT global stratospheric HNO3	Analysis	Global		3-hourly	Reactive gas	HNO3	Ozone & Ultraviolet radiation
BASCOE assimilated NRT global stratospheric H2O	Analysis	Global		3-hourly	Reactive gas	H2O	Ozone & Ultraviolet radiation
BASCOE assimilated NRT global stratospheric N2O	Analysis	Global		3-hourly	Reactive gas	N2O	Ozone & Ultraviolet radiation
BASCOE assimilated NRT global stratospheric HCl	Analysis	Global		3-hourly	Reactive gas	HCl	Ozone & Ultraviolet radiation
BASCOE assimilated NRT global stratospheric HOCl	Analysis	Global		3-hourly	Reactive gas	HOCl	Ozone & Ultraviolet radiation
SACADA assimilated historical global stratospheric ozone	Reanalysis	Global			Reactive gas, Greenhouse gas	O3	Ozone & Ultraviolet radiation
BASCOE assimilated historical global stratospheric ozone	Reanalysis	Global		12-hourly	Reactive gas, Greenhouse gas	O3	Ozone & Ultraviolet radiation
BASCOE assimilated historical global stratospheric HNO3	Reanalysis	Global		12-hourly	Reactive gas	HNO3	Ozone & Ultraviolet radiation
BASCOE assimilated historical global stratospheric H2O	Reanalysis	Global		12-hourly	Reactive gas	H2O	Ozone & Ultraviolet radiation
BASCOE assimilated historical global stratospheric N2O	Reanalysis	Global		12-hourly	Reactive gas	N2O	Ozone & Ultraviolet radiation
BASCOE assimilated historical global stratospheric HCl	Reanalysis	Global		12-hourly	Reactive gas	HCl	Ozone & Ultraviolet radiation
BASCOE assimilated historical global stratospheric HOCl	Reanalysis	Global		12-hourly	Reactive gas	HOCl	Ozone & Ultraviolet radiation
TM3DAM global total ozone record	Reanalysis	Global			Reactive gas, Greenhouse gas	O3	Ozone & Ultraviolet radiation
Total ozone multi sensor reanalysis	Reanalysis	Global			Reactive gas, Greenhouse gas	O3	Ozone & Ultraviolet radiation
Updated inventory of European emissions based on RETRO	Surface fluxes	Europe			Reactive gas, Greenhouse gas, Aerosol		Emissions & fluxes
Global solar UV index monitoring	Analysis	Global		3-hourly	Reactive gas, Aerosol, Radiation	UV index	Ozone & Ultraviolet radiation
Global solar UV index forecast	Forecast	Global		3-hourly	Reactive gas, Aerosol, Radiation	UV index	Ozone & Ultraviolet radiation
RAD-SOLAR archive of surface solar irradiance	Analysis	Global			Radiation		Solar radiation
Origin of forecasted pollution episodes (graphic presentation)	No						

Regional AQ forecasts with source-allocation capabilities (internet-based)						Air quality & atmospheric composition
Ensemble regional AQ reanalysis for Years 2007, 2008 & 2009 (web-based)	Reanalysis	Europe		Reactive gas, Aerosol		Air quality & atmospheric composition
Delayed-mode fluxes of global carbon dioxide	Surface fluxes	Global	3-hourly, Monthly	Greenhouse gas	CO2	Emissions & fluxes, Climate forcing
Delayed-mode fluxes of global methane	Surface fluxes	Global	Monthly	Greenhouse gas	CH4	Emissions & fluxes, Climate forcing
Delayed-mode simulations of global carbon dioxide	Analysis	Global	3-hourly, Monthly	Greenhouse gas	CO2	Climate forcing, Air quality & atmospheric composition
Delayed-mode simulations of global methane	Analysis	Global	Monthly	Greenhouse gas	CH4	Climate forcing, Air quality & atmospheric composition
Near-real-time forecasts of global atmospheric carbon dioxide	Forecast	Global	3-hourly	Greenhouse gas	CO2	Climate forcing, Air quality & atmospheric composition
Delayed-mode stand-alone retrieval of methane from SCIAMACHY	Observations	Global	Daily	Greenhouse gas	CH4	Climate forcing, Air quality & atmospheric composition
Delayed-mode stand-alone retrieval of methane from GOSAT	Observations	Global	Daily	Greenhouse gas	CH4	Climate forcing, Air quality & atmospheric composition
Delayed mode stand-alone retrieval of methane from IASI	Observations	Global	Daily	Greenhouse gas	CH4	Climate forcing, Air quality & atmospheric composition
Reanalysis of global atmospheric carbon dioxide over 2003-2011	Reanalysis	Global	3-hourly, Monthly	Greenhouse gas	CO2	Climate forcing, Air quality & atmospheric composition
Reanalysis of global atmospheric methane over 2003-2011	Reanalysis	Global	Monthly	Greenhouse gas	CH4	Climate forcing, Air quality & atmospheric composition
Reanalysis of global carbon dioxide fluxes over 2003-2011	Surface fluxes	Global	3-hourly, Monthly	Greenhouse gas	CO2	Emissions & fluxes, Climate forcing
Reanalysis of global methane fluxes over 2003-2011	Surface fluxes	Global	Monthly	Greenhouse gas	CH4	Emissions & fluxes, Climate forcing
NRT Biomass burning emissions of carbon & various trace species based on assimilated Fire Radiativ	Surface fluxes	Global	Daily	Reactive gas, Greenhouse gas, Aerosol, Fire	Fire Radiative Power	Emissions & fluxes
Biomass burning emissions of carbon & various trace species based on observed Burnt Area (BA) fo Surface fluxes	Surface fluxes	Global	Daily	Reactive gas, Greenhouse gas, Aerosol, Fire	Biomass burning emissions	Emissions & fluxes