

Working with the Emission DataBase (EDB)

**How to construct a dynamic emission database
and simulate emission scenarios**

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Amendments

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3.1 Introduction: What it is All About

A Database, Which Also Includes a Sophisticated Simulation Tool

The Airviro emission database (EDB) is not only a database. In fact the main emphasis has been placed on the user interface, the simulation models and the output facilities. A diagram explaining the structure of the EDB can be found in *Appendix 1C: Structure of an EDB*.

How does EDB client work?

Airviro has is a web based user interface. Airviro can be used from a PC or any other device running Internet Explorer 6 or later and Firefox.

After logging in on Airviro the EDB module can be selected. All data processing is made on the Airviro server and the results are transferred to the web browser.

Please note that JAVA JRE (run time plugin) must be installed and enabled in the web browser.

The EDB includes tools for management and administration of the emission sources.

A Structured Way of Storing Emission Data

The tables provided enable you to describe:

- Emission from
 - Point sources - all the emission is concentrated in a very small area, such as a chimney or stack. Information describing the stack conditions must be given for use in the Dispersion models.
 - Area sources - emission is evenly distributed over a rectangular area and is assumed to leak out.
 - Road sources - the emission is assumed to be evenly distributed over a line. This is normally used as an approximation for road traffic.
 - Grid layers - background emission levels can be defined in the form of grids.
- Time and temperature variation of emission
- Different road types describing traffic patterns
- Vehicle characteristics and speed-dependent emission factors

as well as other features that help you to convert obtainable information into emission figures.

Simulating "What Happens If..." Scenarios

Once you have started filling in your EDB with data, you will appreciate the ability to search for emission. The search facility allows you to specify exactly what sources you are interested in finding out the emission from, especially if you have created your EDB in a structured way. You can search using combinations of the following restrictions:

- Source name and information strings
- Point, area, road or grid sources, or a combination
- One or several fuel types, substance groups and formulae
- One or several road types and vehicle types
- Congestion vehicle and speed
- Any combination of search keys
- A restricted area of the map
- Restrictions on time and temperature

Using the search keys you will be able to find out emission figures such as:

- The total emission of SO₂ from heating plants at 6 o'clock in the morning
- The contribution to the total NO_x emission of heavy vehicles in the city centre at rush hour
- The emission of toluene from paint spraying industries in the northern part of the town when the outside temperature is over 20 degrees

In this chapter a number of examples and recommendations on how to use the EDB software will be presented. If you follow the recommendations you can easily simulate the consequences of hypothetical situations such as:

- What would happen if heavy vehicles were removed from the city centre?
- What would be the effect of changing the speed limit on the main roads?
- What reduction of emission could be expected if low sulphur oil was introduced?

Integration with Dispersion Models

Within the Airviro environment, the dynamic EDB is directly linked to the dispersion models, allowing you to combine different emission scenarios with various dispersion conditions. Given the weather and the parts of the day or year that you are interested in, relevant emissions will be used as input data to the dispersion calculation.

In the *Airviro User's Reference, Volume 4: Working with the Dispersion Module*, you will find examples on how to utilise the EDB for dispersion simulations.

The Report Generator

The report generator or Output can be used to extract information from the EDB for presentation on the screen, storage in a file or as a printout. You can obtain selected static data such as source locations and emission factors, as well as time dependent information concerning emission loads for a given period and area. Also, you can obtain a standardized output for road noise emission levels (colour-coded range).

This output can be configured for source, grid, noise and report (only ASCII Text). You can produce reports in different formats (GIF, PDF and ASCII Text) for being used with other applications.

How to Collect the Relevant Information to be Stored in the EDB

Normally when you work with the EDB we recommend that you initially collect information directly from industry, local authorities, etc. and store the information in the EDB. If you work through the examples in this chapter you will be able to design suitable questionnaires.

Later on, you should be able to carry out dispersion calculations based on the EDB for historical periods and compare the results with measured ambient data. By simulating different wind directions and weather conditions you have a good chance of identifying sources that are not properly described in the EDB. Try to correct the emission data by collecting new information. If this method does not improve the results, we recommend that you use the Receptor Model to estimate emissions (Dispersion Module)

When you are satisfied with the historical simulation results based on the EDB, you are ready to work with real time dispersion applications (now casting) or forecasts for the next 24 hours.

3.2 Getting started

After logging in the application by entering a username and password (*Figure 3.2.1*), the user is presented with a list of all available Domains (if none has being previously selected and stored), By selecting a Domain the top menu list will be refreshed to show all available Airviro Modules. See *Figure 3.2.2*

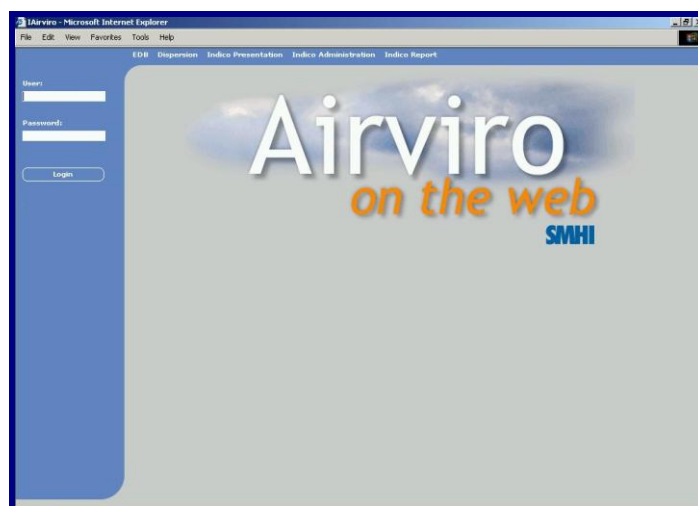


Figure 3.2.1 Logging Airviro



Figure 3.2.2 Select Domains

In this section you will learn how to set up the EDB module so that it is ready to use. This includes:

- Selecting an EDB to work with - either the global EDB or a personal EDB
- Creating a new personal EDB by either copying another EDB or by copying the empty EDB
- Customising some of the menu texts
- Adding new substances to the substance list
- Creating substance groups

- Working with the map

Some of the examples shown here are based on real sources from the Airviro (Göteborg) Reference System, included in all delivered Airviro systems.

3.2.2 Selecting the EDB to Work with

After EDB is selected among the available modules on the top list, the EDB module will be opened and a new list of options or submenus will appear on the left side of the window.

When working with **Edb**, you will be able to make new emission databases or to edit existing ones. If you decide to make a new one, then it may be convenient to copy and rename an existing database and then making the necessary changes.

Start your session by selecting an **Edb**, clicking the option **User&Edb** in order to open this menu (*Figure 3.2.2.1*). There are two list boxes labelled **User** and **Edb**. If you click on **global** in the list box to the left and then press the **Apply** button, it means that you have chosen to work with the global EDB.

The **Description** textbox can be used to describe the contents of the database. You can add a description to the Edb by entering some text and pressing the button “**Save Description**”.

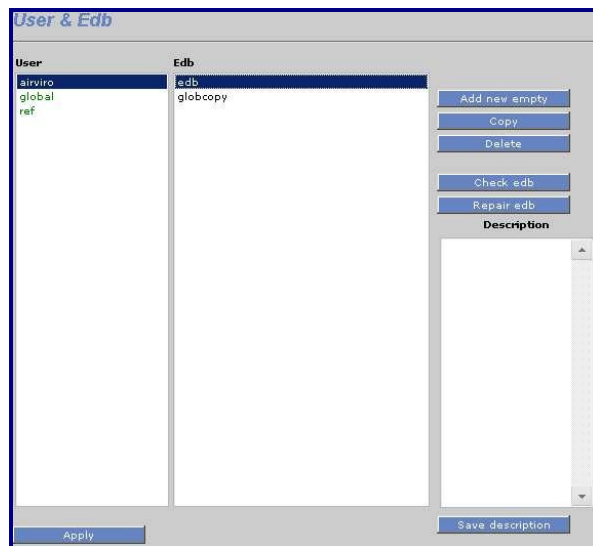


Figure 3.2.2.1 Select user and Edb

Note: A global EDB is the official, original emission database in the system consisting of formulae, emission factors and emission figures that should be approved and supported by the system manager. Usually, no one but the system manager should be able to edit the global EDB. However, any user can examine the contents of the global EDB or make a copy, rename it and then edit and change its content.

Note: It is possible to set up privilege levels in the Airviro system so that different users can have different privilege levels for different emission databases. It should be the task of the system administrator to make sure that the global EDB can only be edited by responsible persons and that other users can make their own personal copies of the global EDB if needed. It is not only the global EDB that can be protected in this way. Privilege levels can also be set up for a user's personal EDBs. If you have trouble accessing an existing EDB that you think you should be able to access then ask your system administrator about your privilege levels.

Creating a New Copy of the Global EDB

Normally, you are not allowed to edit the global EDB, so we suggest that you make your own copy. Click on **Edb** again under **Copy** and click in the left box on your user identity. Your user identity is the same name as you typed when you logged in to the computer. Your personal Edb will be shown in the list box on the right hand side.

You create your own copy of the global EDB by clicking on the push-button **Copy** to the right. A subwindow named **New Edb** appears. See *Figure 3.2.2.2*. Type a suitable name in this subwindow. Confirm by clicking **OK**.

You now have a new copy of the global EDB. The new name appears in the right list box.

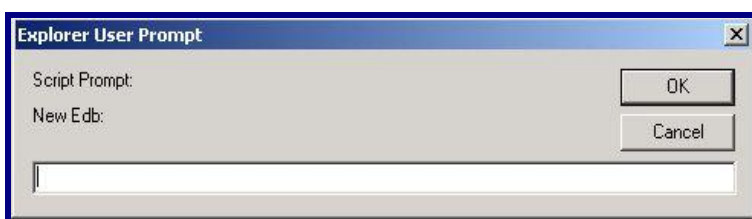


Figure 3.2.2.2 Add new Edb and Copy

Creating a Copy of Someone Else's Personal EDB

The **Edb** subwindow:

- Select the Edb you want to copy by clicking on it, and then clicking on **Copy**
- The **New EDB** subwindow will appear. Enter a name for your copy in the text field. See *Figure 3.2.2.2*.
- Click on **OK**.

Check that you have received a copy under your own user identity, with the name that you typed.

Note: It is even possible to set privileges on individual EDBs so that other users cannot even view them or copy them. This is done in the privilege level file, which should be maintained by the system administrator.

Deleting a Edb

You can easily delete any one of your own personal Edb

Within the **User & Edb** subwindow:

- Click on the personal Edb that you want to delete and then click on **Delete**
- The **Question** sub-window will appear. Confirm or cancel your order.

Note: It is usually only possible to delete your own personal Edb. If you choose a personal EDB owned by any other user, or the global EDB, then the **Delete** button will be disabled. The ability to be able to delete other Edb's can however be configured in the privilege level file which should be maintained by the system administrator.

Creating a New Empty EDB

Within the **User & EDB** subwindow:

- Click on **Add new empty**
- The **New EDB** subwindow will appear. Type the desired name for your copy beside **Name**. See *Figure 3.2.2.2*.
- Click on **OK**.

You have now created an empty Edb.

Exercise 3.2.2.2

Create an empty personal EDB with the name: **My_first_EDB**.

Check and repair EDB (only version 3.13)

Click on **Check edb** if you want the system to check the consistency of a personal EDB.

Click on **Repair edb** if you want the system to repair a personal EDB.

3.2.3 Altering Basic Settings Texts

Select your personal Edb: **My_first_EDB**, which should be empty. This EDB has been created with default texts but it is possible to alter some of them. You should only alter texts in an empty EDB, that is before you start entering data, because these texts will apply to every single source in the EDB.

For looking at the currently defined texts, select **Basic Setting** under the **Subtables** menu. Here you will see a list of texts that can be defined by the user: **Scenario** texts, **Speed** texts, **Temperature** texts, Searchkeys, activity codes, geographical codes and Units.. Choose one of them, for example **Scenario....** A subwindow appears showing the default scenario definitions - consecutive years starting from the year 2003. But what if you have emission estimations for

the year 2015? To be able to incorporate these figures into your EDB, change one of the scenarios (e.g. change scenario 10) to 2015. Now, whenever you enter or edit a source, the year 2015 will appear in the scenario list in the 6th position. See *Figure 3.2.3.1*.

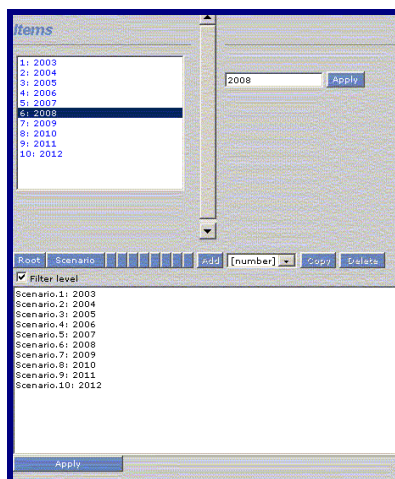


Figure 3.2.3.1. Basic Setting

You can alter the speed and temperature texts too, as they have been set up to comply with Swedish traffic (i.e.) and weather conditions but might not be so relevant to other countries.

3.2.4 Adding Substances to the Substance List

Select the global EDB. This contains the default list of substances, which is also used for all local Edb. To examine the substance list:

- Click on **Subtables**
- Select **Substances...**

A list of substances will be presented as in the figure, and is also included in the appendix. If you use the scrollbar to the right you will find out that there are 1023 positions for different substances. These are grouped in categories depending on the type of chemical substance. This substance list has been adopted by several Airviro installations. We recommend that you do not change the positions of existing substances, but you may introduce any new substances at free positions in the substance list.

Position	Substance Name	ID
0		512
1	NO	513
2	NO2	514
3	NOx	515
4	HNO3	516
5	HNO2	517
6	PAN	518
7	NH3	519
8	N2O	520
9	PM10	521
10		522
11		523
12		524
13		525
14		526
15	SO2	527
16	H2SO4	528
17	SO3	529
18	H2S	530
19	CS2	531
20		532
21		533

Figure 3.2.4.1 Substances

Note: There is only one substance list shared by the global EDB and all local Edb's. The list can only be changed in the global EDB, so you must have edit privileges for the global EDB if you want to make changes to the substance list.

WARNING: The Edb does not recognise the substance name that you write in the substance list. It looks for the position, which means that there are 1023 substances with internal names: 1 to 1023. Later, when you define a source of emission you have to define what substances are emitted from that source by pointing in the substance list at the position where you have written the desired substance name. If you then change substance names between positions in the substance list, you have to redirect the pointer from all sources to the correct positions in the substance list. Consequently, you should set up the substance list as completely as possible before you start to fill the Edb with information.

3.2.5 Substance Groups in the EDB

In several applications it would be convenient to define *substance groups* as a specific mixture of substances defined in the substance list. If you define a substance group called **standard petrol**, and define the percentage of different hydrocarbons, lead, etc. this would simplify and structure your work later on when you are to define all sources emitting gases from **standard petrol** or if the composition of **standard petrol** needs to be changed.

To define a substance group:

- Select the **Subs. Group** submenu in the **Subtables** menu to the left
- The **Substance groups** subwindow appears, then press the **Add button**.
- Type a name for the new substance group in the text field **Name**.

- From the substance list, choose the individual substances by clicking on them. (Keep Shift or Ctrl key pressed to select more than one item). Then confirm your choice by clicking on the arrow button.
- In **Data** enter the weight percentage of the individual substances in the text area in the list box: **Emission (%)**
- Confirm your choice by clicking **Apply**. The choice is saved when the legend “setting saved” appears.

The example above shows a substance group that has been created to describe hydrocarbon emission from vehicles and is a particularly illustrative example of how substance groups can be used. Many different hydrocarbons are emitted from combustion of petrol, and we have details about a few of them. The substance group consists entirely of hydrocarbons from petrol, therefore we enter 100% for the substance HC Traffic. However contained in HC Traffic we know there are about 4% benzene, 12% toluene and 13% total xylenes. We can link the description of hydrocarbon emissions from cars to this substance group instead of just to the substance HC Traffic. In this way we have the option of searching for either total hydrocarbon emission or for one of the individual hydrocarbons.

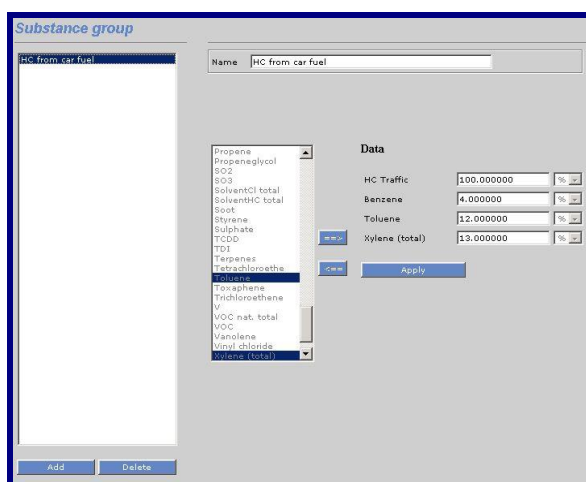


Figure 3.2.5.1 The substance group subwindow

Exercise 3.2.5.2

Define a substance group called **Standard Petrol** consisting of 5% Benzene, 12% Toluene and 3% P-Xylene.

3.2.6 Choosing a Geographical Area

Selecting a Map

Some systems have several maps within Airviro. You can choose between maps in the Source subwindow by using the option button the *Figure 3.2.6.1*. Some systems have several maps within Airviro. You can choose between maps. For example in this figure is select Gothenburg.



Figure 3.2.6.1. Map

Selecting a Geographical Subarea Within a Map

When you have selected a map, it is possible to zoom in the map:

Click on the **Zoom In** button in the map area. (*Figure 3.2.6.1*). A white hair cross will appear when you move the mouse pointer onto the map.

Move the hair cross to a geographical point that you want to define as a corner in the zoomed area. Click on the left mouse button and drag the mouse to stretch a rectangle. Release the mouse button when you are satisfied with the marked area.

The chosen subarea will be redrawn on the screen.

Note: As the map is vector based, you can zoom again in the zoomed area. However the resolution in the zoomed area will usually not be better than in the original map. There are two exceptions: the road network and the visual effects of having more picture elements on the screen per square metre of the geographical area. There is also a limit of how small an area can be zoomed into.

To Restore the Maximum Area Map

If you have zoomed in your map and would like to display the original (maximum) size of the map, then click on the push button **Whole** in the map dialogue area (button up the map)

To restore the last Zoom Area Map

If you have zoomed in your map and would like to display the last size of the map, then click on the push button **Zoom Out** in the map dialogue area.

Pan

If you have zoomed in your map and would like to display the other area map with the same scale, then click on the push button **Pan** in the map dialogue area.

To Clear a Map

If you have displayed emission information on top of the map you can always clear the map area (displaying only the map) by clicking on the push button **Clear** in the map dialogue area.

3.2.7 Notes on Filling in Tables in the Edb

When entering data into an EDB you will often come across large tables that have to be filled in with emission factors.

It is very important that there are no extra spaces in the table.

By default, tables are created with the value 100 in each cell.

3.3 Point sources in the EDB

In this section you will learn the basic ideas behind entering point sources in the Edb. The emission from a point source can be defined in one of three ways:

1. By defining the total amount of each substance emitted in a year
2. By defining the total amount of a substance group emitted in a year
3. By linking the source to a fuel and defining its maximum effect

The following steps will be explained:

- Information required when entering a point source
- Time and temperature variation formulae
- Static information needed for dispersion modelling
- Using the search conditions to find out emission figures from your source
- Creating a fuel type
- Defining a point source based on fuel consumption

3.3.1 What is a Point Source?

If the air pollutants are emitted from

- a well defined position
- a small restricted volume

then we define the source as a point source. An emitting stack or chimney is a typical point source. In the Edb, you can describe the effect of heat and momentum fluxes on point source emissions, i.e. information that is necessary in order to make realistic dispersion simulations from a stack.

3.3.2 General Principles

When adding a point source to the Edb the following information must be given:

- **Name information** gives the name of the source plus two information strings. These strings can be used as search conditions when searching in the EDB.
- **General information** such as the name of the company, address, contact person, etc. This information is needed to maintain the database.

- **Dynamic information** is the information that directly controls the emission, such as formulae that describe the emission as a function of outdoor temperature or as a function of day type and hour.
- **Static information** such as chimney height, exhaust gas temperature, coordinates, etc. These figures do not affect the emission strength, nor do they vary over the year, but they are required in order to describe the exact location of the initial pollutant plume. This type of information is vital for the dispersion simulations.
- **Emission** from the source either directly in terms of the substances emitted, or linked to a substance group or fuel type.

It is also possible to link the emission to a *Indico Presentation* macro. Instead of specifying the emission for a substance it is possible to select a macro.. A macro must be previously defined in *Indico Presentation*. The unit of the resulting time series from the macro must be g/s.

- **Search keys** - it is possible to define five groups of search keys in order to structure the pollution sources into groups that can be used to separate the total emissions. The first two groups have space for 128 search keys each and the other three groups have space for 32 search keys.

3.3.3 Dynamic Emission: Formulae for Time Variation and Temperature Effects

Before giving any general or static information it is important to create a formula that describes the typical variation of the emission. In most cases of emission within a large city we know that the variation of emission is of the same order of magnitude as the long-term average emission. If you start with an empty Edb there is one default formula in the system, the so-called **STANDARD** formula that contains a time constant emission and no temperature dependency.

The emission variations defined in the formula tables are interpreted in two principal ways as a consequence of linking either a substance, a substance group or a fuel to a formula:

- Substance, substance group: yearly variation is given as absolute values but all other variations are normalised
- Fuel: all variations are given as absolute values

We will begin by considering the first group as this expresses a more general formulation of emission variations. In *3.3.7 Introducing a Point Source Based on Knowledge About the Emission Process* we will discuss the second alternative to be used for emission variations where we have information about the emission process.

To create a formula:

- Click on the **Formulas** under **Subtables in** the EDB menu, then the Formula subwindow will appear.
- Click on **Add** (or click on **STANDARD** if you want to edit the default formula)

- Type in a formula name in the **Name information** text field
- Define the yearly variation on **Configuration** by clicking on **Day type**, **Temp & Gas Velocity** or **Scenario & Month**

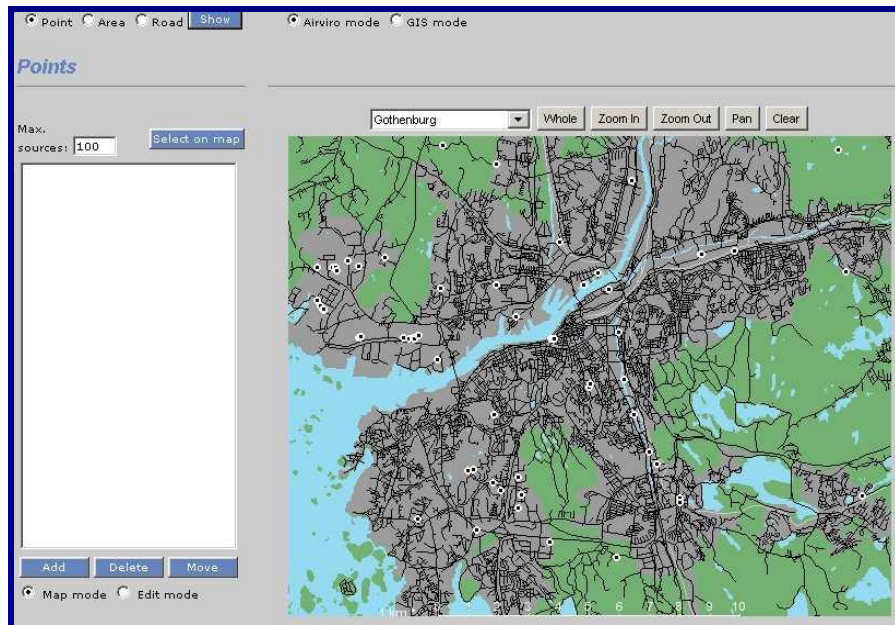


Figure 3.3.3.1. The Point subwindow

The **Formula / Scenario & Month** subwindow will appear showing 10 text fields marked with yearly figures. In these text fields you can describe the absolute variation of emission in percentage over the years.

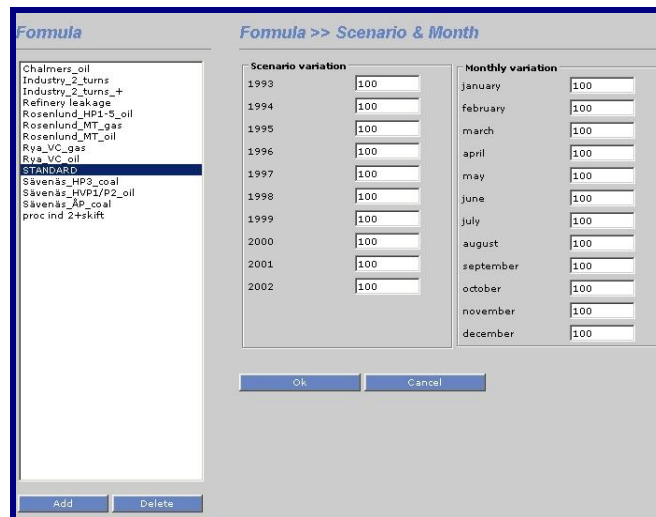


Figure 3.3.3.2. Scenario and Month

Normally you should type 100 for the present year, meaning a factor equal to 1. If you estimate that the yearly emissions will double by the year 2000, then type 200 in that text field.

Note: The scenario names are texts that can be changed by the user, these can be modified and saved under **Basic Setting** (EDB menu).

Confirm the table (**OK**) and leave the subwindow.

- Define the monthly variation by clicking on **Scenario & Month**

The **Scenario & Month** sub window will appear containing 10 Scenario variations, and 12 Monthly variation text fields labelled for each month of the year. In these text fields you can describe the relative variation of emission during the year. The figures entered here will be normalized at the moment EDB uses them to estimate emissions. This will be explained mathematically in **Appendix 1B**, and you will see the effects and understand the principles later on when you perform dispersion calculation (simulations).

Example1: If you write 100 for all months but put June and July = 0 then no pollutants will be emitted during these summer months, but the total yearly emission will be evenly distributed over the other ten months. If you had written 200 instead of 100 for all months except June and July the result would have been the same.

Example2: If you write 75 for 6 months (October-March) and 25 for the other 6 months (April-September), then emission will be three times higher in the winter than in the summer. You will get the same result if you had given the figures 300 and 100 instead of 75 and 25.

Figure 3.3.3.3. Temperature and Gas Velocity variations

When you are ready, click on **OK** and leave the subwindow.

Note: These figures are **not** normalised if linked to a source defined in terms of a fuel.

- Now define the emission dependency on outdoor temperature by clicking on **Temperature & Gas velocity**

The **Temperature & Gas velocity** subwindow will appear and a column with 30 text fields marked with the outdoor temperature intervals is displayed. See Figure 3.3.3.4. In these text fields you can describe the relative variation of emission as a function of the outdoor temperature. This is explained mathematically in Appendix 1B: Mathematical Definitions of the Formulae Used in the EDB. In 3.3.5 *Specifying a Point Source Based on Yearly Total*

Emission Figures and 3.3.7 *Introducing a Point Source Based on Knowledge About the Emission Process* examples will be given showing how to use this table.

- Click on **OK** to save the temperature information
- Define the exhaust gas velocity by clicking on **Temperature & Gas velocity...**

The **Gas velocity** subwindow will appear and a column with 20 text fields is displayed. In these text fields you can describe the *relative variation* of exhaust gas velocity as a function of the production rate. See *Figure 3.3.3.3*. Maximum gas velocity has to be given as static information when you define the point source (see 3.3.4 *Static Emission Information* and 3.3.6 *Emission Simulation from a Point Source*). The information on exhaust gas velocity is important in order to compute the so-called plume lift. In large power plants the exhaust velocity from the stacks can vary substantially depending on the production rate. This is further explained in 3.3.7 *Introducing a Point Source Based on Knowledge About the Emission Process*.

- Click on **OK** to save the gas velocity information

Exercise 3.3.3.1

Create a formula named **industry_2shift** where there is a constant emission during working days between 6 a.m. and 10 p.m., and no emission at all during other times of the day (or during weekends). The industry is completely closed in July.

Day type variation	Mon-Thu	Fri	Sat	Sun
00 - 01	0	0	0	0
01 - 02	0	0	0	0
02 - 03	0	0	0	0
03 - 04	0	0	0	0
04 - 05	0	0	0	0
05 - 06	100	100	0	0
06 - 07	100	100	0	0
07 - 08	100	100	0	0
08 - 09	100	100	0	0
09 - 10	100	100	0	0
10 - 11	100	100	0	0
11 - 12	100	100	0	0
12 - 13	100	100	0	0
13 - 14	100	100	0	0
14 - 15	100	100	0	0
15 - 16	100	100	0	0
16 - 17	100	100	0	0
17 - 18	100	100	0	0
18 - 19	100	100	0	0
19 - 20	100	100	0	0
20 - 21	0	0	0	0
21 - 22	0	0	0	0
22 - 23	0	0	0	0
23 - 24	0	0	0	0

Figure 3.3.3.4. Day type variation

- Define the daily and hourly variation by clicking on Day type...The Day type subwindow will appear and 4 columns with 24 text fields marked with the day types: Monday-Thursday, Friday, Saturday and Sunday are displayed. There are 24 text fields in each column defining the hours during the days. In these text fields you can describe the relative variation of emissions during the week. The figures you enter will be normalised at the same moment EDB uses them to estimate the emissions. This is explained mathematically in **Appendix 1B**, and you can see the effects and understand the principles later on when you perform simulations.

Example3: If you write 100 for all hours during Monday-Thursday and Friday but 0 over the weekend then no pollutants will be emitted during Saturday and Sunday but 7/5 of the weekly average emissions will be emitted during workdays.

- When you are ready, click on **OK** and leave the subwindow.

3.3.4 Static Emission Information

There are important emission characteristics that do not affect the emission strength, but must be known in order to utilise the emission information in a dispersion model so that the effect of emissions in the ambient air can be determined.

The static information is defined as:

- **Chimney height.** It is important to know the release height when we apply a dispersion model. Generally speaking: the higher the stack is, the lower pollutant concentration on the ground close to the stack.
- **Inner diameter** of chimney and **Exhaust gas velocity** are used to compute the vertical displacement of the pollutants before the horizontal wind and turbulence transports the pollutants and mixes them down to lower levels. We use these figures to compute the so-called *effective stack height*.

It is also important to know the **Exhaust gas temperature** when we want to determine the *effective stack height*. If the gas is considerably warmer than the surrounding air, then the buoyancy effect will create a large plume lift.

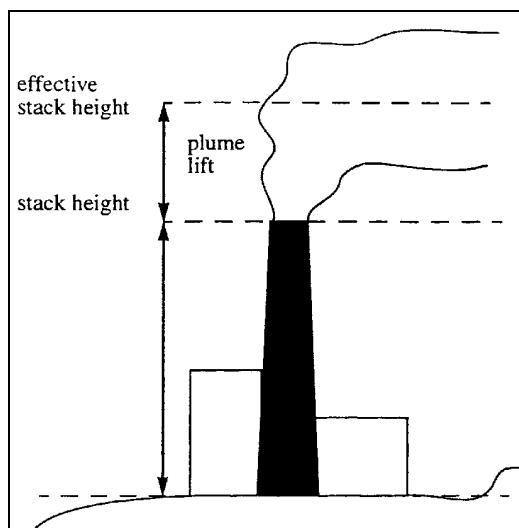


Figure 3.3.4.1. *Effective stack height*

The **Outer diameter** of the stack as well as large buildings in the vicinity affect the wind flow close to the stack and consequently the dispersion pattern. In some cases a considerable down draught can occur creating high concentrations of pollutants on the ground close to the source.

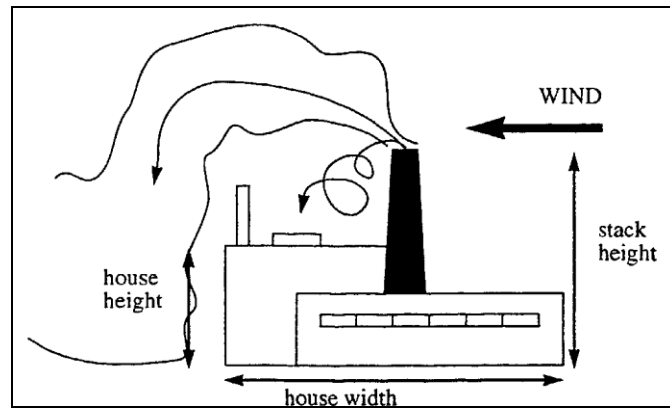


Figure 3.3.4.2. Buildings

Buildings can create an effect if the stack is less than 2.5 times as high as the buildings. You should give the dimensions of the largest nearby building, as this will have the greatest influence.

Note: The static information is not necessary in order to simulate emissions in the EDB but it is vital if you want to simulate the air quality effects using the dispersion models in the Dispersion module. Therefore we recommend that you always document the static information as soon as you add a point source to the EDB.

3.3.5 Specifying a Point Source Based on Yearly Total Emission Figures

You are now ready to introduce the first point source in the EDB. The first example is based on a typical situation from real life. You have asked Mr. John Smith, the environmental manager of a medium size company (a cement factory) about the emissions of NO_x .

He has given you the total emission during the year and indicated the periods during which the factory is closed. Additional information about stack height, exhaust temperature, etc. has been given and the information can be summarised as follows:

Company name: Cement and Son Ltd.

Total yearly emission of NO_x : 600 tons

Stack height: 45 m, outer diameter: 2 m, inner diameter: 1 m.

Stack mounted on a building of dimension $50 \times 40 \text{ m}^1$ and height 32 m.

Exhaust gas temperature: 12°C , velocity: 8 m/s

Production on working days (Monday-Friday) between 6 a.m. and 10 p.m. Closed in July.

1. The house width should be calculated as $\sqrt{\text{length} \times \text{width}}$

Mr. John Smith estimates that the production will increase by about 10% per year until the year 2000.

Please remove this. Note: Remember, you can describe sources with other characteristics for each Domain. These are activities and geographic codes, other characteristics entered by the user are Alob and collect ER.

How to Specify your First Point Source in the EDB

Click on **Source** in the EDB main window and then click **Select on the map**. A hair cross will appear when you move the mouse pointer over the map area and the computer waits for you to select an area. Press the right mouse button to enter the **Point** subwindow without having to select a subarea.

Name Information	
Name	[name of the company]
Info	
Info2	
X1 Coord	1266122
Y1 Coord	6403908
X2 Coord	0
Y2 Coord	0
Latest change	971014
Formula	industry_2shift
Searchkey 1	none
Searchkey 2	none
Searchkey 3	none
Searchkey 4	none
Searchkey 5	none

Buttons: Additional info, Emission substance, Aermod, Codes, Alob, CollectER, Apply

Figure 3.3.5.1. Point source

Note that it is only necessary to select a subarea if you want to edit an existing point source or if you want to copy information from an existing source to a new source. To select an area, hold down the left mouse button and drag it over the area you want to choose, then release it.

The **Points** subwindow appears, and in the list box to the left all existing sources in the selected area are shown. In this case, working with the personal EDB: **My_first_EDB**, there should not be any existing sources.

Click on **Add** and the hair cross appears in the map area. Select the desired location of the source by positioning the hair cross and clicking on the left mouse button. The **Point** subwindow appears again and then click on **Edit mode** for you can start to fill in information.

- Start to fill in the name of the company in the upper text field **Name**
- Continue to fill in the **Additional Information** and
- If you want to change the location of the source on **X Coord** and **Y Coord**
- Select the proper **Formula** by clicking on **industry_2shift**
- Fill in the emission figure by dragging the option menu button down to **Emission**. The substance emission subwindow appears. Select NO_x from the list box and fill in the total yearly emission (tons/year) in the relevant text field. Confirm by clicking on **OK**.

- All information except **Search keys** and the **Info** and **Info2** string (we will introduce them later on in 3.3.8 *Using Search Keys and Pattern Matching Facilities as Search Conditions*) has been given,
- Select the available **Codes** and **Alob**.

Codes are used to categorize sources in EDB. These can be geographic codes or activity codes. These codes are defined selecting the **Basic Setting** menu

The **Alob** can contain any amount of text. It is used to store data that is impossible to store in the other fields of the point source. If the text in an **Alob** is in tag = value format, these can be used as search criteria. Example:

```
NO_CARS=12
FUEL_CONSUMPTION=1000
```

Figure 3.3.5.2. Codes

Figure 3.3.5.3. Alob

- PI: Remove this. Select the **CollectER** available. CollectER is available only for defining point sources.
- PI: Remove this. Estimating emissions at the level of countries, states, regions or provinces and even larger companies in most cases is a knowledge-intensive exercise. Guidelines, guidebooks and other guidance documents to prepare emissions inventories typically contain thousands of pages with emission estimation methods and specific and aggregated

emission factors for large numbers of sources. The European Environment Agency's compile the emission inventories with the ColR.

The EIC Module is designed for storing and managing emission inventory data from CollectER.

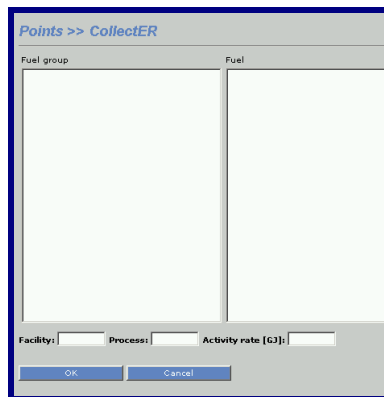


Figure 3.3.5.4. CollectER

- Fill in the **Aermod** menu, with the emission characteristics. They will be used in the Dispersion Module (Aermod Model). Width, height, length, centre, and distance to the farthest wall, must be entered for each building. All values must be in meters.

At least one segment must be defined for each point source.

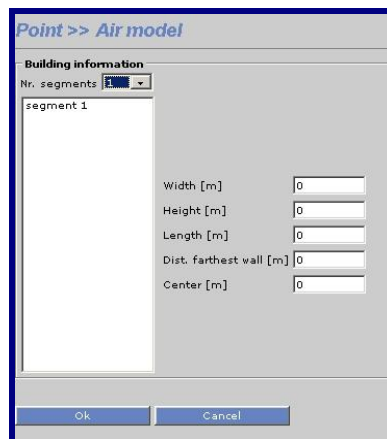


Figure 3.3.5.5. Air Model

- Finally, save the information by clicking on **Apply**.

3.3.6 Emission calculation from a Point Source

We can use a point source to perform an emission calculation. Emission calculations are performed using the **Search criteria** subwindow. The search is carried out over the map area that you see on the screen, so that if you have zoomed into a subarea then only that subarea will be searched.

Click on **Search Criteria** in the EDB main window. The **Search criteria** subwindow will appear on the screen. See *Figure 3.3.6.1*.

Figure 3.3.6.1. Search criteria

The **Search Criteria** subwindow:

- **Name Information:** The three text fields **Name**, **Info** and **Info2** gives you the possibility to write the characters you want to match when searching for sources in the Edb. If you write **Cement and Son Ltd.** in the **Name** text field then the sources with exactly that name will be found, and no other sources. There is the possibility to use so-called "wild cards" in connection with the strings. For example: If you write **Cem*** then all sources with a name starting with **Cem** will be selected. For further information see 3.3.8 *Using Search Keys and Pattern Matching Facilities as Search Conditions*.
- **Substance:** You must select a substance from the substance list.
- **Sources:** You can select any combination of point, area and road sources. For example, if you enable the **Point** and **Area** toggle buttons then only point and area sources will be included in the search.
- **Correction:** this consists of three choices: **Correction** gives you the possibility to multiply the emission from point, area and road sources with an arbitrary factor.
- **Variation:** **Scenario** allows you to change to a different scenario. If you select **Time & temp** the **Time and Temp** subwindow will appear. You can give selection constraints concerning time such as: Month, Day type, Hour and Temperature. This gives you the possibility to compare emissions such as the emissions during rush hour on Mondays in September with daily emissions on Saturdays in June. The **Temperature** gives you the possibility to prescribe the outdoor temperature or the frequencies of outdoor temperature. Instead you can activate the **Dependent on time** option, in which case a temperature distribution based on the time restrictions that you have made will be automatically included.

From / To is used when calculating the emission from a certain time period. If the EDB contains sources that uses time series to define the emission, this is the only way to calculate the emission from these sources.

PI. Remove this. NOTE: Since version higher than 3.13 you have also the possibility to filter the information using the radio button FROM: /TO: to select the information that match this filter criteria.

- **Restrictions** consist of four subwindows.
 1. **Point, Area & Grid** restrictions give you the possibility to select point/area/grid sources that are defined with a specific **Substance group, Fuel** and/or **Formula**. Defined restrictions are applied simultaneously (using Boolean AND criteria). A maximum of 10 selections can be made in each list.
 2. **Road** restrictions give you the possibility to select line sources (traffic roads) that are based on a specific **Road type, Vehicle** type and typical **Speed** on the road (see 3.6 *Traffic Emissions in the EDB*). A maximum of 10 selections can be made in each list.

Restrictions can be define according to the number of vehicles per day (minimum and maximum) and road length (minimum and maximum).

3. **Search key** restrictions give you the possibility to estimate emissions from sources that have been given specific search key (see 3.3.8 *Using Search Keys and Pattern Matching Facilities as Search Conditions*). An unlimited combination of search keys can be made.
4. **Sub area** restrictions allow you to define a geographical area in which to perform the search for emission sources.
5. **Codes** and **Alob** restrictions gives you the possibility to filter information according to the codes that were previously defined.
6. **Apply**, save all settings.

Output Setting emission rates are usually expressed as grams per second (g/s) or the other units. There are four different output functions:

1. **Normal** output means that all sources that fulfil the search criteria will be displayed on the map (on the screen), both location and emission strength. You can use the option *Show emission sources with nr of decimals*. A maximum of 8 decimals can be select in each list.
2. **Grid** output means that you can define a grid with a user-defined resolution over the map or a subarea within the map. The total emission in each grid cell will be displayed using graded colours. You define the grid resolution, colours, etc.
3. **Report** is the EDB Report Generator, only Txt format. Here you can define several types of reports to display information from the EDB. The Report Generator is described in 3.8 *Creating EDB Reports and displaying the Database structures*.

4. **Noise** output means that all road noise emission levels will be displayed with different colours on the map. This is standardized with colour-coded range.

Example. Make the following selection in the **Search Criteria** subwindow:

Search strings:	Name: Cem*				
Substance:	NOx				
Sources:	Point				
Restrictions:	-				
Variation: Time & temp:	Scenario: 1993	Month: all	Day type: all	Hours : all	Temperature: not used
Variation: Corr. Factors	Point: 1	Area: 1	Road: 1		

Click on **Output** (Gif or PDF) .The position of the source Cement and Son Ltd. will be displayed and the emission estimation is 19 g/s. That is exactly what will be emitted as an average during the period you have selected. If you instead ask for the figure expressed as tons/year, you will be given the answer 600 tons, i.e. the yearly emission figure that you gave when the source was defined.

Click on **Search Criteria** and change the time constraint to:

Variation:Time & temp:	Scenario: 1993	Month:all but July	Day type: Mon-Fri	Hours: 6-22	Temperature: not used
---------------------------------------	-------------------	-----------------------	----------------------	----------------	--------------------------

i.e. the production period at the factory. Click on **Output** (Gif or PDF) and then the estimated emissions will be 43.6g/s. This is the mean emission rate coming from the stack during production time. The yearly emission equivalent would represent what the total emission would be during a year if the factory were running all hours and days during the year with that emission rate.

Exercise 3.3.6.1

Simulate the mean emission for Fridays during the period May-September. The answer should be 23.3 g/s.

Simulate the yearly mean emission at the year 2000 (Hint: use the correction factors). The answer should be 20.9 g/s, which is 660 tons per year - exactly a 10% increase on the present mean emission.

Note: When converting between g/s and tons/year it is assumed that there are 365.25 days in a year.

3.3.7 Introducing a Point Source Based on Knowledge About the Emission Process

In many cases you will not gain information about the total emission during a year, but information about the process that causes the emission.

To incorporate all the information we know about such a source we have to work through the following steps:

1. Create a formula describing the time and temperature variation of the source
2. Create a fuel type specifying the energy value and the emission either as grams per mega joule or as a percentage of the fuel weight.
3. Create a point source linked to the formula and fuel type and specifying the maximum effect of the process.

The following example shows typical information given from a fossil-fuelled power station used for district heating.

Heat production for hot water consumption at night time (10 p.m. – 6 a.m.):
10 MW

Heat production for hot water consumption at day time (6 a.m. – 10 p.m.):
20 MW

Heat consumption as a function of the outdoor temperature:

Outdoor temperature	20°	15°	10°	5°	0°	-5°	-10°
Heat consumption	0 MW	20 MW	40 MW	60 MW	80 MW	100 MW	120 MW

Maximum effect of the boiler: 100 MW

Type of fuel: Oil (43 MJ/kg)

SO₂ content: 0.2%

NO_x production in the process: 0.1 g/MJ

Stack height: 85 m, outer diameter: 2 m, inner diameter: 1 m.

Stack mounted on a building of dimensions 50*40 m and height 32 m.

Exhaust gas temperature: 120 °C, velocity: 15 m/s

If we analyse this information we find that the heat consumption including the hot water will exceed the capacity of the boiler at lower temperatures than 0° during daytime and roughly –2° in the nighttime. Obviously the energy company must supply energy from an additional production unit when the consumption exceeds the maximum capacity of the boiler above. If we had been given information about the additional capacity of production (and emission), we would have been able to include this information. However, in this case we are explicitly interested in describing the emission from one specific boiler as we want to focus on the possibility of simulating the emissions in a realistic way, i.e. so that differences between day and night time, temperature dependency and maximum emission are properly described.

In order to introduce the information in the EDB we start to define a **Formula** named **oil_boiler** in the same way as in *Exercise 3.3.3.1*. The relative figures in the monthly, daily, and temperature tables have to be defined as *relative to the maximum production rate*. Consequently, in the **Day type** table you should write 10 (%) during nights and 20 (%) during daytime for all day types. In the **Temperature** table, you should convert the heat consumption figures to percentage figures (actual heat consumption/maximum heat production). No specific information has been given regarding monthly or yearly variation. Consequently, we write 100% in the **Month** and **Scenario** tables.

After you have saved the formula you have to define a **Fuel**. Within this database you can define the emission as a function of a burning process and a fuel involved in that process.

- Click on **Subtables** and then on **Fuel...**. The **Fuel** subwindow will appear.

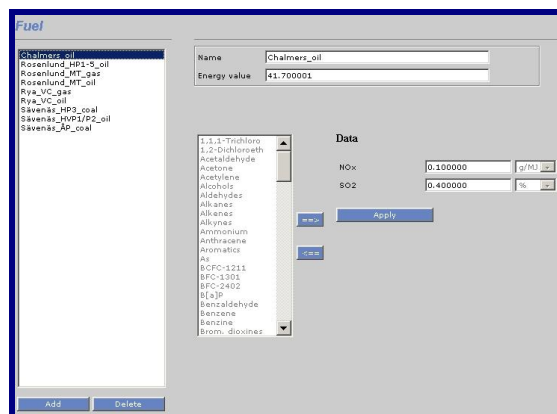


Figure 3.3.7.1 Fuel

Click on **Add** and type the name **oil_example1** in the **Name** text field and the Energy value in the next text field

Emission (g/MJ): click on **Substances...** and fill in the NO_x value 0.1 g/MJ

Emission (%): click on **Substances...** and fill in the SO₂ value 0.2%

Save the settings and leave the subwindow (**Apply**)

The next step is to define the source:

- Click on **Source**. The **Point** subwindow will appear. Click on **Add** and select a position on the map. Then, type in the **Name** of the source (oil boiler) and complete the **Additional info...** based on the information above. Select the **Formula** oil_boiler.
- Click on the **Emission** option menu and choose **Fuel**. The Fuel emission subwindow will appear. Select a fuel: oil_example1 and type the maximum production effect (100 MW) in the text field. Click on **OK**.
- Save the point source information, click on **Apply**.

The emission from this source can now be calculated in the following way:

1. For NO_x (which is emitted in g/MJ) the emission formula is

$$\text{Total Emission [g/s]} = f_a \times \text{MaxEffect [MJ/s]} \times 1000 \times \text{RelativeEmission [g/MJ]}$$

2. For SO₂ (which is emitted in % weight) the emission formula is

$$\text{TotalEmission[g / s]} = f_b \times \frac{\text{MaxEffect[MJ / s]}}{\text{EnergyValue[MJ / kg]}} \times 1000 \times \text{RelativeEmission[\%]}$$

where f_a and f_b are factors created from the scenario, month, day type, temperature and gas velocity tables. The factor of 1000 in the second equation is to convert the result from kg/s to g/s.

To verify the emission figures we go back to the **Search Criteria** subwindow and set the following values:

Search strings:	Name: oil*				
Substance:	Nox				
Sources:	Point				
Restrictions:	-				
Variation: Time & temp:	Scenario: 1993	Month: all	Day type: all	Hours : all	Temperature: Yearly mean
Variation: Corr. Factors	Point: 1	Area: 1	Road: 1		
Output:	Normal	No. of decimals: 1			

For NO_x the mean annual emission is 216.8 tons/year.

For SO₂ the mean annual emission is 100.8 tons/year.

Exercise 3.3.7.1

Manually change the temperature settings, specify the hour of the day, and simulate the emissions for the following cases (you can search for a certain temperature interval by specifying 100% for that interval and 0% for all other values):

Outdoor Temperature	20°	15°	11°	5°	1°	-1°	-3°	-5°	-10°
Emission NO _x at 12 o'clock	1.02	1.86							
Emission SO ₂ at 12 o'clock									

Fill in the table.

3.3.8 Using Search Keys and Pattern Matching Facilities as Search Conditions

The Search Keys

All emission sources in the EDB can be classified using five groups of search keys. In the first two groups there are 128 individual search keys and in the last three there are 32 in each group. The benefits of the search keys are obvious by looking at some examples:

Assume that you have a large number of districts (municipalities) in your territory. Utilize the first group of search keys by defining all districts by name in the first search key list. In the second search key list you may group different activities that contribute to pollution, such as **Petrochemical industry, Automotive industry, Traffic, Lawn mowers**, etc. In the third search key list you can categorize your emitters into classes such as: **Private industry, State owned industry, Public sector, Private consumption**, etc. In the fourth you may categorise the area in which the emitter is located, such as: **rural, sub-urban, residential, inner city**, etc.

Later on when you want to estimate the total emission from lawn mowers in a certain district in the residential areas you can have your answers very quickly. If, before filling the emission database with figures and formulas, you analyse your future needs concerning emission estimation, you will find that the search keys can play an important role, giving you a convenient emission database handler.

You will benefit from constructing and utilising good search key lists. They provide a very efficient way of searching in the database for certain groups of pollution sources. You can search using unlimited combinations of search keys from the different searchkey lists.

The Search Strings

The **Search strings (Name, Info1 and Info2)** that can be given for all sources can be extremely valuable as a complement to search keys. The first string (**Name**) consists of 47 characters. It is

the intention that you should include the name of the source in this string (such as **Oxford street** or **Shell**, etc.). In addition you are free to fill the whole string with characters and numbers that can be valuable to classify the source in a convenient way. As an example you can provide a national identification code, property code, etc. If you provide unique characters as separator between the information, it will be easy (as demonstrated in next paragraph) to use matching facilities when searching for emissions in subsets of the database.

The two extra strings Info and Info2 consists of 47 characters and can be used in the same way as **Name to input information related to the emission source.**

Matching Search Keys

When simulating emissions using the **Search Criteria** subwindow you can restrict your search in the database by clicking on **Searchkeys**. In this subwindow you can select more than one search key for each one of the five groups.

If you have chosen more than one search key in a group, all sources belonging to any key in the selected subset will be extracted from the database (*or-criteria*). If you have chosen combinations in two search key groups, then sources belonging to any key in the selected subset in the first group and any key in the selected subset in the second group will be extracted from the database. Between groups we have an *and-criteria*.

For example: Suppose you have selected **district1**, **district2** and **district3** in the first search key group, and **Lawn mowers** and **traffic** in the second, but no selection in the next three groups. The following sources will then be extracted from the database:

Sources with 5 search key definitions such as:

- a) District1, Lawnmowers, Private consumption, Resident, Green
- b) District2, Lawn mowers, -, -, -
- c) District3, Traffic, -, -, Yellow

The following sources will **not** be extracted from the database:

- d) District1, Petrochemical industry, Private industry, Sub-urban, Black
- e) -, -, -, -, Brown
- f) District3, -, -, -, -

The - indicates that no search key definition has been made.

Matching Search Strings

In the **Search Criteria** subwindow, you are free to select a specific source by defining the **Search** strings so they match a specific source. But if you want to match all the sources that have some characters or numbers in common in the search string definition you can apply the following pattern matching possibilities:

A*	All strings beginning with an A (capital letter)
*street	All strings ending with street
street	All strings that contain the word street
street *avenue*	All strings containing the word street or avenue
?A*	All strings in which the second letter is an A
[Aa]*	All strings that begin with an A or an a
[A-F]*	All strings that begin with capital letters between A and F
^K*	All strings that do not begin with an K
*[^h-k]	All strings that do not end with small letters between h and k

Examining the matching capabilities, you will realise that a carefully prepared strategy concerning search string definitions will allow the user to have unlimited possibilities of selection criteria.

Note: When filling in the name and information strings for a source, you should not use the reserved characters |, *, ^, \$, ., [,], {, }, ?.

3.3.9 Saving your search criteria and output settings

When you have defined all search criteria, you may save the query as an EDB macro. The EDB macro saves all settings in the user interface, so they can be used at a later stage.

When **Load Macro** menu is selected, a new window appears that allows the user to load a macro previously defined and saved in any of the groups created. Individual groups can be created for each user using the same name, or a common group for all users. **Save Macro**, allows you to save macros, and **Delete Macro**, allows you to remove existing macros.

This concept is the same for output settings. The macro saves all defined restrictions on **Search criteria** and **Output settings**.

It is recommended that you save your Macro with a meaningful filename so that you can easily recognize the content.

3.4 Area Sources in the EDB

3.4.1 What is an Area Source?

An area source is a pollutant source that is widely spread over an area. The leakage from pipes, valves and tanks at a refinery is a typical example of an area source. Usually we don't know exactly the locations of emission, so we treat the whole area as a source and assume that the emission is evenly distributed.

The static information that is used for point sources is not included in the area sources. In the representation of the area source, the map is divided up into grid squares, and the emission in each square is calculated. This reduces simulation time so that it can happen that an area source simulation runs quicker than a point source simulation, if there are many small point sources. In a simulation, the area source emission will take place 2 m above the ground and there is no emission velocity.

3.4.2 General Principles

In the EDB you can define an area source as a rectangle. To include an area source in the EDB is very similar to the inclusion of a point source, but instead of clicking on a point you must define an area by dragging the mouse on the map.

Emissions can be defined using an Indico macro. The macro must be previously defined using Indico Presentation.

The general principles are the same as for point sources. You can save the search and output settings. You can use **Formulae**, **Fuel**, etc. in the same way you do for point sources. PI: Remove this. except for Aermოდ and CollectER options.

3.5 Grid Layers in the EDB

3.5.1 What is a Grid Layer?

A grid layer in the EDB is a collection area sources spread over a large area. These sources are grouped into a grid layer. A typical example is household heating: is it often possible to estimate the amount of fuel that is consumed in each area of a city. From this information is it possible to create a grid of emission sources.

For each grid layer the information that is common for all grid cells is stored only once. Only the information that might be different is stored for each grid cell. The emission from each grid cell is always stored.

It is of course possible to store the emission sources in the grid as area sources instead but the grid layer solution has some advantages compared to the area sources:

- Increased computation speed.
- Disc space requirements will decrease, often quite dramatically.
- The import format for grid sources is simpler than the format for area sources.

3.5.2 General Principles

A grid layer can only be created with the grid ASCII interface, a shape file or **Wedbed**. The geographical information about the grid, the data that is specific for each grid cell and the common information is used as input at creation time.

The menus for the grid layers are exactly the same as for area sources but only the common information of the grid layer can be modified. Another difference is that the emission from a grid layer must be specified as substances or substance groups. The grid can use only the option **Codes**.

Click on **Grid** in the menu bar , and when pressing the **Grid Source** option, the following window appear, and allow input the grid source (*Figure 3.5.2.1. Grid Sources*).When pressing the **Grid Import** option, the following window appear, and allow import the grid source (*Figure 3.5.2.2. Grid Import*).

Figure 3.5.2.1. Grid Sources

Figure 3.5.2.2 Grid Import

3.6 Traffic Emissions in the EDB

3.6.1 What is a Road source?

A road source is a mathematical idealisation that does not exist in reality. When we talk about road sources we generally mean emission from road traffic. Every car moving on the road is more or less a point source, although we can never locate or follow any individual car. For the EDB user it is quite convenient to define the road traffic (or may be shipping route traffic, etc.) by drawing a line on the map.

In urban areas, the dominant part of the air pollution can be derived from road traffic emissions. Consequently, the quality of the work concerning traffic emission data is the most crucial part in the construction of an EDB. However, the number of roads and cars in a large city are so numerous that we need to simplify the handling of the data. Below you will find a description of the principles of the Airviro traffic emission data processing. The method described can be refined but is still very efficient in terms of manpower needed to set up a traffic emission database for a large urban region.

3.6.2 General Principles

You can, in an interactive way, define the positions of a road graphically on the map/screen. When the position of the road is fixed, you have to give information on traffic speed, traffic intensity and variation as well as information on the types and proportions of vehicles operating on that road.

However, the traffic behaviour is likely to be similar on several roads. Consequently, the traffic variation as well as proportions of different vehicles on a road can be defined in groups of Road types.

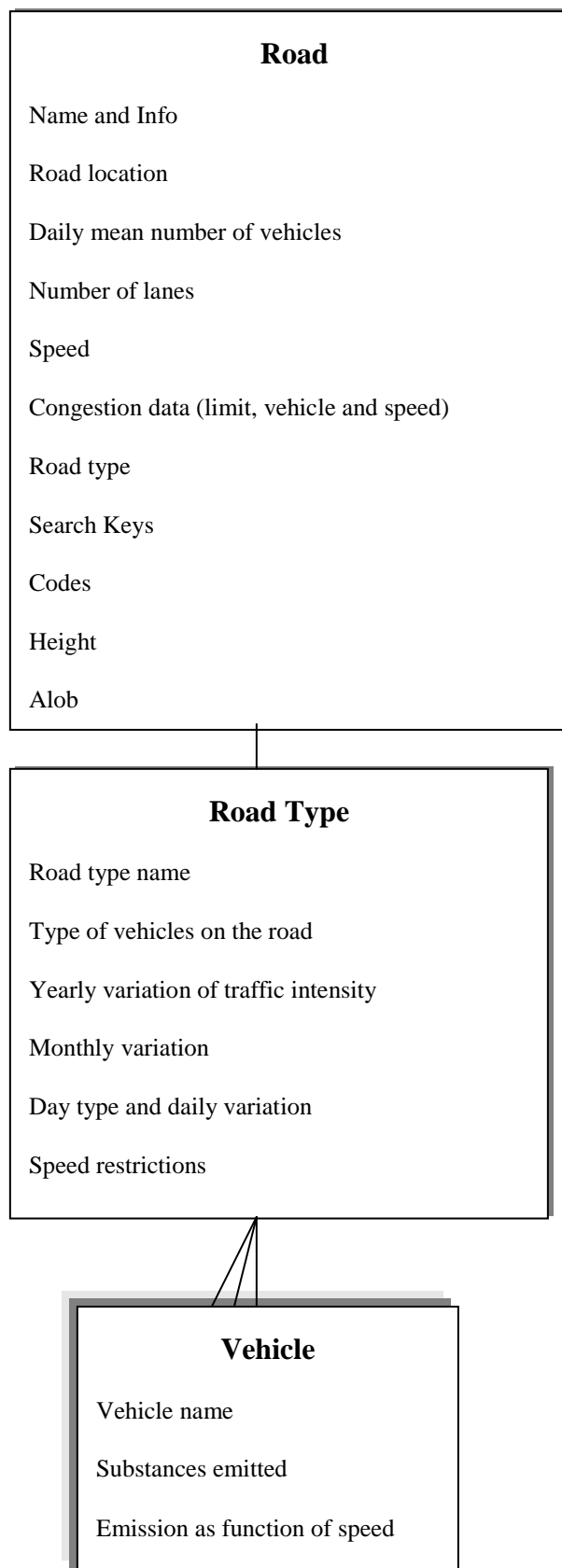
The typical number of Road types that you will have to define is likely to be 10-25 depending on the complexity of the area. Instead of defining all traffic variation characteristics on each road, you simplify the work by addressing the information to be found in the **Road type** database.

The emission factors from different vehicles are found in the **Vehicle** database. The emission factors in the **Vehicle** database are referred in the **Road type** definitions in the **Road type** database. To be able to simulate traffic emissions it is likely that you have to define 5-25 different emission tables in the **Vehicle** database.

The typical amount of traffic information that you have to supply in order to describe the traffic emissions in a large city is:

- **Roads:** 500-1000 roads or road links

- **Road types:** 10-25 different road types
- **Vehicles:** 5-25 tables with emission factors from different vehicles.



3.6.3 Introducing Emission Factors for Vehicles

Emission from vehicles is mainly dependant on:

- The type of vehicle, classified depending on the engine type, fuel used, weight class, ambient temperature and pavement types.
- The driving behaviour and the general traffic environment.
- The speed the vehicle is travelling at.

In many countries, emission factors have been derived based on the factors above. You are able to include these in the EDB. Sets of emission factors are included in the **Vehicle** database in the Airviro Reference database. The emission factors are basically derived as functions of:

- **Substance** NO_x, CO and total HC
- **Speed** 0-120 km/hour
- **Type of vehicle** Light vehicles and Heavy vehicles (>3.5 ton)

To include the driving pattern, separate emission factors are given in various traffic situations. Consequently, vehicles that are driving in the centre of a city tend to accelerate and slow down more than vehicles on a highway. The name: **Lv cat tho 50 10s** represents the emission factors for light vehicles (**lv**) equipped with catalytic converters (**cat**), driving on a through-road (**tho**), signed maximum speed: 50 km/hour (**50**), and the vehicles have to make 10 stops or turns/km (**10s**).

The way in which it has been chosen to structure the road types and vehicle types is based on a Swedish model, the VETO model, and this model is used here as a typical example. Other models exist that are not quite the same but you should be able to adapt the EDB to these other traffic models when you define road types and vehicle types. You may also want to refine your traffic EDB by introducing other important processes, e.g. defining vehicles with higher emission due to low temperatures in the combustion process (cold start), etc.

If you click on **Subtables** and then on **Vehicle...** in the EDB main window the **Vehicle** subwindow will appear.

In the left list box you can see all the different emission factors that are given in the Reference database. If you would like to define a new vehicle type and the corresponding emission factors, you simply click on **Add** in the lower left corner. To edit an existing vehicle, click on the proper vehicle in the left list box. If it is a new vehicle, you have to name it by typing it in the upper right text field. You can define or add a substance by clicking in the list box named Substances.

To edit or add the emission factors as a function of the vehicle speed. You can see the substances, which are defined to be emitted from the vehicle type. The **Speed table** to the right, is disabled until you have clicked on a specific substance. As soon as you have chosen a substance the **Speed table** will be enabled and you can add or edit the emission factors as a function of the vehicle speed.

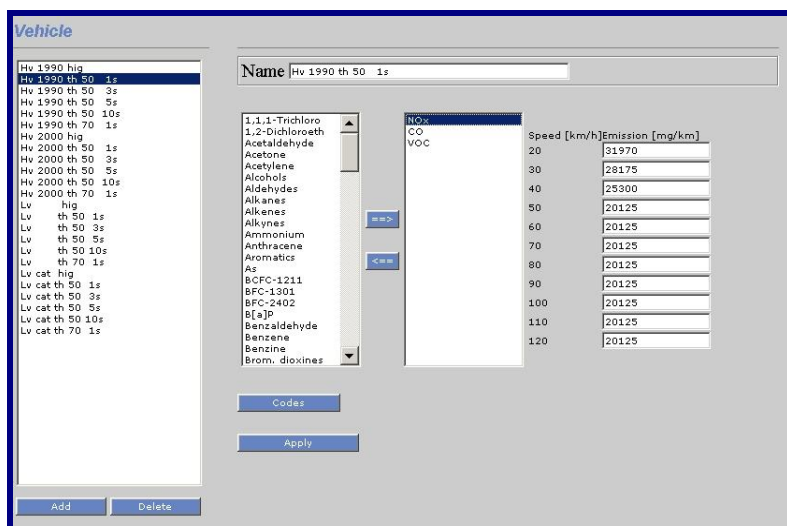


Figure 3.6.3.1 Vehicles

In the example shown the vehicle **Hv 1990 tho 50 1s** and substance nitrogen oxides (NOx) have been chosen. A table of emissions as a function of speed will appear as illustrated in the figure. You can edit the table and save your modified emissions by clicking on **Apply**.

3.6.4 Naming Standard for Emission Factors

There are several reasons why you should name your different emission factors in a structured way. As soon as you start to work with the **Road types**, you will recognise an obvious reason to have a corresponding name convention in order to link different emission factors to the corresponding **Road types**. In the model used in the Airviro Reference database, the name of the emission factors is defined by the characteristics: vehicle type and traffic environment, i.e. the emission factors are constructed in the following way:

Example	Type of Vehicle	Vehicle subset	Type of Road	Signed maximum speed	Number of stops/turns per km
Lv cat hig	Light vehicle	Catalytic converter	Highway	90	0
Hv 1990 tho 70 1s	Heavy vehicle	Old type	Through road	70	1
Lv tho 50 10s	Light vehicle	No catalytic converter	Through road (city street)	50	10

3.6.5 Introducing Road Types

To be able to simulate the emissions at a specific hour caused by the traffic, we need to know the typical traffic variation on the streets and roads. However, from a practical point of view, it is not possible to define the traffic time variation separately for every road and street in an urban region. In the EDB it is assumed that typical traffic behaviour can be categorised in classes. These classes are called Road types and consist of:

- Proportions of different vehicle types on the road
- Yearly index (expected increase or decrease of traffic in the future)
- Monthly variation
- Daily variation (within 4 different day types)
- Hourly variation
- Speed restrictions

In order to define a road type, click on **Subtables** and then click on **Road type...** in the main window. The **Road type** subwindow will appear; now, in order to edit an existing road type select one in the list box to the left. To create a new **Road type**, click on the **Add** button, at the bottom of the list and enter a name for the new road type in the **Name** text field. The next step is to define the type of vehicles that operates on this road type. Select the proper vehicles in the **Vehicles** list box on the right side. To define the rates of vehicles you have to click on **Scenario...**

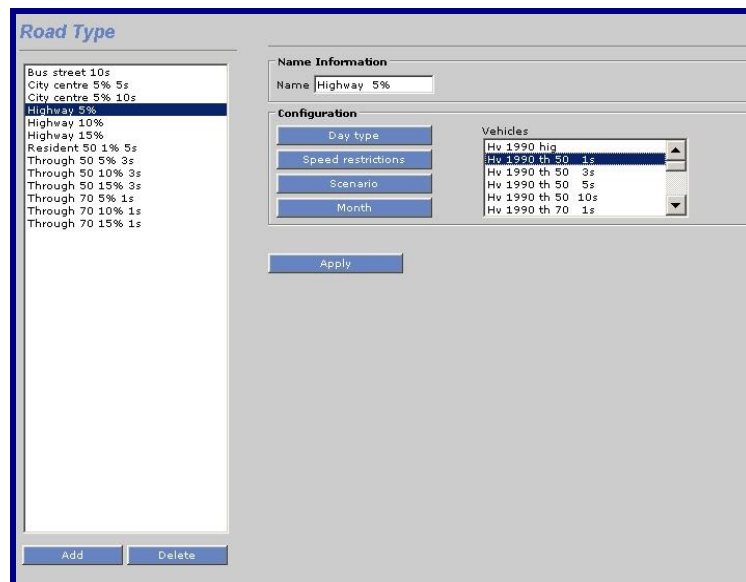


Figure 3.6.5.1 Roads Type

The **Scenario** subwindow appears and you are able to fill in the percentage of the different vehicle types. You can define the expected rates for up to 10 different years or scenarios. This table is basically the same as the **Scenario** table in the **Formula** database, i.e. the figures will be treated as absolute values (as percentage) *and will later on be multiplied by*

a daily total number of vehicles on a street. The scenario figures in the **Road type** definition can be used to forecast future changes in the traffic intensity, vehicle rates and accordingly the future emissions caused by traffic. Save your figures and leave the subwindow by clicking on **OK**.

Note: if the percentage for a specific scenario sums up to 100, the daily total number of vehicles will multiply the number 1.00. If the sum had been 120 for a different scenario, then the daily total number of cars on a specific street will multiply the factor 1.20.

As for the yearly variation, you can define monthly variations by clicking on **Month....** Note that this table is similar to the **Month** table in the **Formula** database, i.e. all figures are relative and will be normalized when used. Save your monthly figures and leave the subwindow by clicking on **OK**.

You can define hourly traffic variation by clicking on **Day type...** . The **Day type** subwindow will appear, and the principles here are similar to the **Day type** table in the **Formula** database. By clicking on one of the existing vehicles on the **Vehicles** list box on the left, you can fill in the hourly traffic variations in the text area. Please note that the figures are relative, i.e. they will be normalised as described in 3.3.3 *Dynamic Emission: Formulae for Time Variation and Temperature Effects*. Save your daily figures and leave the subwindow by clicking on **OK**.

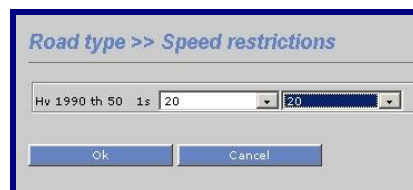


Figure 3.6.5.2 Speed restrictions

Finally, you can define speed restrictions for the different types of vehicles operating on the Road type. Click on **Speed rest...** and the **Speed restriction** subwindow will appear. Click on the desired vehicle in the left list box (**Vehicles**). Now you can prescribe a minimum and a maximum speed for that type of vehicle. This feature is very useful if you want to define speed differences between heavy and light vehicles. Save your speed restrictions and leave the subwindow by clicking on **OK**.

3.6.6 Introducing Traffic Information in the EDB

After you have created emission factors for different types of vehicles as well as a number of typical road types you are ready to introduce road emissions into the EDB. In the main window, select **Road...** . Click on **Select on map**, a hair cross will appear in the map area and the computer waits for you to select an area. To select an area, hold down the left mouse button and drag it over the area that you want to choose, then release it. The subwindow **Road** appears and in the list box to the left all existing roads within the chosen area are displayed. If you click on any of the existing roads the location of it will be displayed on the map. To introduce a new road, click on **Add** in the lower left corner. The

subwindow disappears and a hair cross appears on the map. Position the hair cross on the map at the start of your new road. Click on the left mouse button. Move the hair cross to the next position of your road. A rubber band will be stretched between the last position and the hair cross. Find your new position and click on the left mouse button. Continue in this way until you have defined the whole road extension. Then click the middle mouse button (escape) or right mouse button to return to the subwindow.

Figure 3.6.6.1 Roads

Now you have to fill in the characteristics of the road. Start with the road name in the **Name** text field, and a code definition in the **Info** text field. The next step is to fill in the traffic information. Fill in the total number of **Vehicles per day** (this should be the yearly mean traffic for a day). Also enter **Number of lanes** (in total), although this field is currently not used. You may also give a **Correction factor**, by which the **Vehicles per day** is always multiplied. This should be 1 if you do not want any correction effects.

Select the typical speed for the road. Remember that the speed is an emission factor. Also define characteristics for traffic congestion, like congestion limit, congestion speed and congestion vehicle.

It is possible to characterize the road traffic by defining the free flow and the congestion. These parameters change the emission factors.

The congestion is the major demand of vehicles that the road can support. It is defined by the number of vehicles that travel per day on the road.

Select a proper road type from the **Road type** list box in the lower right corner. Then select suitable search keys.

Select a geographic or activity code from **Codes**. It is the same concept used for point sources. Remember these codes are defined on **Basic Settings**.

You can input complementary information about surrounding buildings (slope, distance to house, house width and house height). For this you must use the button **Height**.

And then, you select a characteristic from button **Alob**. It is the same concept used for point sources. Remember these codes are defined on **Basic Settings**.

Finally, you can enter the noise factor with the following parameters: vehicle speeds, proportion of heavy goods vehicles, gradient and type of the surface (e.g. bitumen, concrete and porous asphalt). Remember, that for characterizing a source with noise factor, this must be previously enabled.

Save your road definition by clicking on **Apply**.

3.6.7 Emission Simulation with Road Sources and Restrictions

Simulation of emissions based on road sources are identical to point sources as described in *3.3.6 Emission Simulation from a Point Source*. However, there are certain features unique for the road emission as can be seen in the **Search Criteria** subwindow below.

If you want to simulate road emissions exclusively, you have to put the toggle button **Road** on and both **Point** and **Area** off.

Clicking on **Road...** can see restrictions that are specific for road emissions.

Search criteria >> Road restrictions

Roadtype	Vehicle	Speed
Bus street 10s	Hv 1990 hig	20
City centre 5% 5s	Hv 1990 th 50 1s	30
City centre 5% 10s	Hv 1990 th 50 3s	40
Highway 5%	Hv 1990 th 50 5s	50
Highway 10%	Hv 1990 th 50 10	60
Highway 15%	Hv 1990 th 70 1s	70
Resident 50 1% 5s	Hv 2000 hig	80
Through 50 5% 3s	Hv 2000 th 50 1s	90
Through 50 10% 3s	Hv 2000 th 50 3s	100
Through 50 15% 3s	Hv 2000 th 50 5s	110
Through 70 5% 1s	Hv 2000 th 50 10	None
Through 70 10% 1s	Hv 2000 th 70 1s	New speed
Through 70 15% 1s	Lv hig	20
	Lv th 50 1s	30
	Lv th 50 3s	40
	Lv th 50 5s	50
	Lv th 50 10s	60
	Lv th 70 1s	70
	Lv cat hig	80
	Lv cat th 50 1s	90
	Lv cat th 50 3s	100
	Lv cat th 50 5s	110

None

Vehicles per day (min and max)

Road length (min and max)

OK Cancel

Figure 3.6.7.1 Roads Restrictions

You can select up to 10 **Road type** restrictions and up to 10 **Vehicle** types. There are no limitations to the number of **Speed** that you can select. (see 3.3.8 *Using Search Keys and Pattern Matching Facilities as Search Conditions*).

In addition you can alter the speed by prescribing a **New Speed**. For example: If you have selected all roads having a signed speed 90 and then select a new speed of 70, then all roads defined as 90-roads will be selected and the emission will be calculated after reducing the speed on the roads to 70.

You can use other restrictions like vehicles per day (minimum and maximum) and road length (minimum and maximum).

3.7 Grid Presentation of Emissions

In previous examples, the emissions have been estimated and presented as figures located at each individual source and summed for the entire displayed map area. In several applications, you might be interested to see the spatial distribution of the emissions indicating hot spots. The EDB provides you with the possibility of defining a grid in which all sources located in each grid square are summed and represented with a colour code.

For displaying emissions as a coloured grid you have to select the **Output Settings** subwindow. Then, choose **Grid** as Output.

The values for **Intensity** goes from -100 (black) to +100 (white), moving in the values RGB. You can use **Color Fade** to reduce the colours in scale of grey. The values for colour fade goes from -100 (grey) to +100 (very grey).

Now, you are free to decide the resolution of the grid. There are two different ways for doing this. If you have toggled for **Grid size**, then you just have to define the length of the grid in the east-west direction (**dx**) and north-south direction (**dy**). These figures are given in metrical units. Your second choice is to toggle for **grid number**. In this case you have to define the numbers of grid squares in the east-west direction (**nX**) and north-south direction. The grid size will now be determined depending on the size of the map area that you have chosen.

Now define the colour table and the emissions intervals corresponding to the emissions per area unit by choosing colours and levels. Colour intervals values can be integer or float numbers and by clicking on the coloured square you will be able to choose a colour from a palette. See *Figure 3.7.1*.

In this window, the user can use the buttons **Colour and Level auto range**, to automatically set the scale for both items and **Colour rainbow range** to automatically set the rainbow scale.

When ready, you click on **Apply**.

It is worthwhile mentioning that if you define your resolution as 50*50 m and search for road emissions, then you will see a nice road map, presenting the roads in different colours classifying them depending on the traffic emissions.

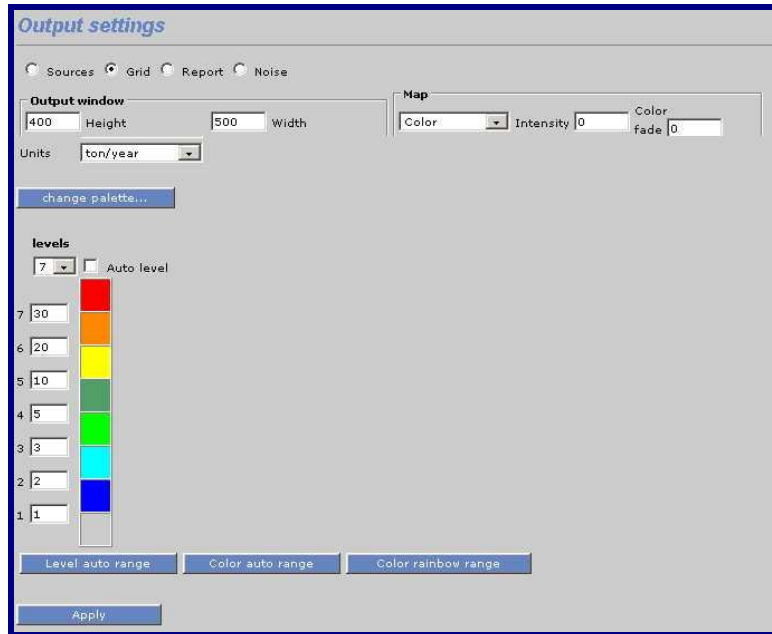


Figure 3.7.1 Output Settings: Grid

3.8 Creating EDB Reports and displaying the Database Structures

The EDB contains many different tables. It is possible to print out summaries of these tables, along with the substance and searchkey lists.

Also, it is possible to create reports containing different information about the sources stored in the EDB

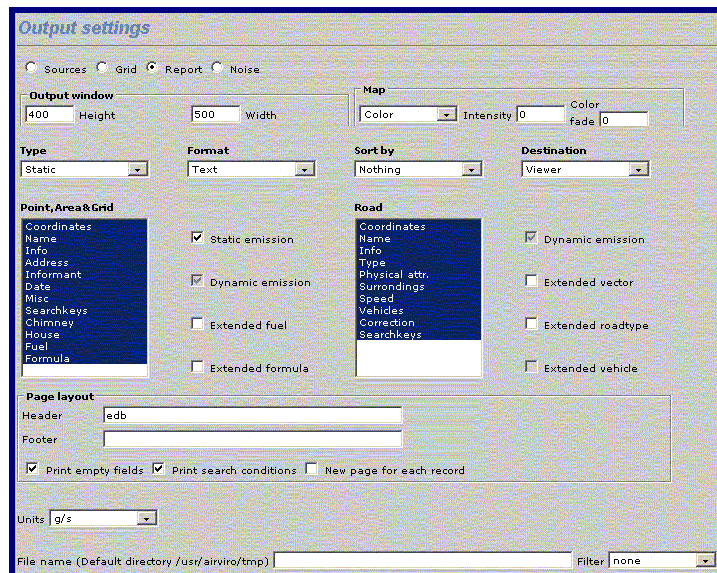


Figure 3.8.1 Output Settings: Report

Choose **Reports** under the **Output Settings**. The report subwindow will appear. PI: Remove this , which is very easy to use.

First you enter the height and width for the output window. Then select colour map, intensity and colour fade.

Select the characteristics of the sources (point, area, grid and road) to be included in the report.

There are two different types of report: **static** and **dynamic**. The **static** reports can only be in **Text** format. The **dynamic** reports also include the emission figures. This can be in a **text** format, **SKV** format (more compact, and useful for exporting the data), **Grid** format or **GIS** format (these two just contain emission data - they provide two different formats that can be used for exporting the emission data to an external dispersion model or to a GIS system).

For roads:

Select **Physical attribute** in order to see the length, width, slope and lanes of the road sources, in the text report.

By selecting **Surroundings** you will include in the report, the distance between buildings and buildings heights.

Under **Destination** you have three choices of where to send the output. If you choose **File** then you type on **File name...** and specify the name of the file to save to.

Under **Page layout...** to specify a header and footer to print on each page and to choose whether to print each record on a new page. You can also choose whether or not to print empty fields or to print the specified search conditions.

If you have chosen **Text, SKV, GIS or GRID** format then you can choose what point, area and road attributes that you would like to be included in the report.

There is also a possibility of applying a **Filter** to the output that can for example alter the format of the output or send it somewhere else such as directly to a floppy disk, or to another computer.

Next you have to decide if you want to print empty fields, such as gaps in the substance list, etc. Usually you don't want this. You can also disable the alphabetic sort and print the database in the order that the EDB stores them. Every member of a database is given a number by the EDB.

The Output Settings sub window is used to select the information that you want to include in the report. This report generator is activated from **Output** menu, in EDB Module.

The report output type, can only use text output. The following is a typical data report output:

The following is an example of the more compact SKV output, and is usually quite suitable to export to other database programs.

```
"X1";"Y1";"X2";"Y2";"Name";"g/s";  
1280000;6410300;0;0;"ANGEREDS VÏRMECENTRUM";0.221816;  
1273730;6400380;0;0;"BEROL NOBEL MÏLN:1";0.0982328;  
1280250;6406300;0;0;"BJÏRNDAMMENS HETV.";0.348568;  
1271750;6402500;0;0;"CHALMERS VÏRMEC:1";0.126752;  
1271751;6402501;0;0;"CHALMERS VÏRMEC:2";0.31688;  
1274000;6399950;0;0;"ERICSSON RADAR:1";0.131505;  
1276540;6406970;0;0;"GRAAB SÏVENÏS";17.3016;  
1268600;6401600;0;0;"GÏTEBORGS STADS BOS";3.1688;  
1270430;6397410;0;0;"HEDLUNDS PAPPER:1";0.00507008;  
1268550;6399350;0;0;"MARCONICENTRALEN";2.24985;  
1280800;6398900;0;0;"MÏLNLYCKE:1";0.522852;
```

3.9 Creating Noise Reports

From the Output settings sub window select **Noise** as Output.

The **Intensity** values goes from -100 (black) to +100 (white), moving in the values RGB. You can use **Color Fade** to reduce the colours in the scale of grey. The colour fade values goes from (grey) to +100 (very grey).

You must define the colour table and the emission intervals that will be used to display the information. You do that by choosing the colour and levels. Colour intervals values can be integer or float numbers and by clicking on the coloured square you will be able to choose the desired colour from a palette.

In this window, the user can use the buttons **Level and Color auto range** to automatically set the intervals for these two items and **Colour rainbow range** to automatically set the rainbow scale.

You can also define your own color palette by pressing the button **change palette**.

When ready, click on **Apply to save changes**.

Then use the **Output** option (menu Module EDB) to visualize the result in GIF or PDF format.

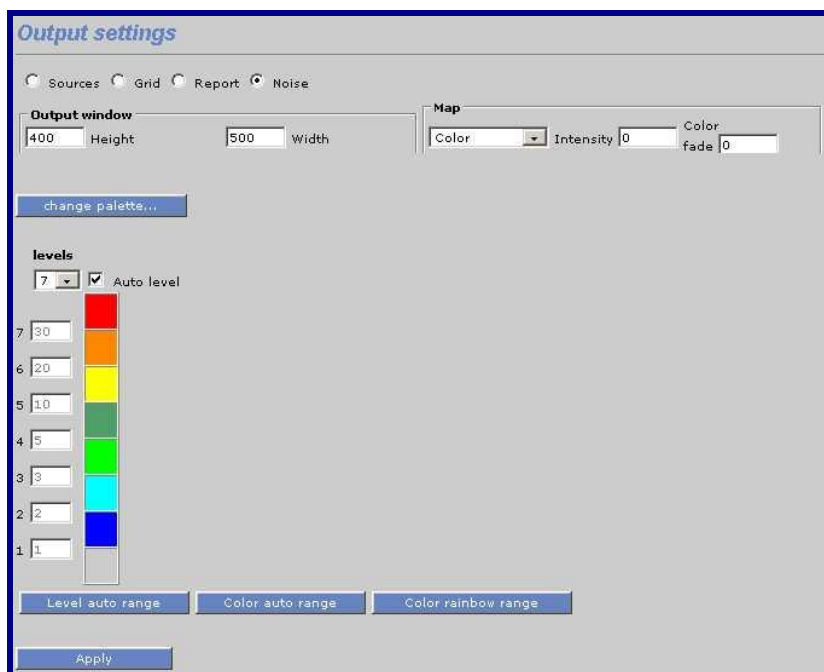


Figure 3.9.1 Output Settings: Noise

Appendix 1A: Suggested Substance List

1A.1 Inorganic Gaseous Substances (1-39)

	Symbol	Position
Gaseous Nitrogen Compounds		
Nitrogen oxide	NO	1
Nitrogen dioxide	NO ₂	2
(NO ₂ 003+ NO)	NO _x	3
Nitric acid	HNO ₃	4
Nitrous acid	HNO ₂	5
Peroxyacetylnitrate	PAN	6
Ammonia	NH ₃	7
Nitrous oxide (laughing gas)	N ₂ O	8
Gaseous Sulphur Compounds		
Sulphur dioxide	SO ₂	15
Sulphuric acid	H ₂ SO ₄	16
Sulphur trioxide	SO ₃	17
Hydrogen sulphide	H ₂ S	18
Carbon sulphide	CS ₂	19
Gaseous Carbon Compounds		
Carbon monoxide	CO	25
Carbon dioxide	CO ₂	26
Other Inorganic Gaseous Substances		
Ozone	O ₃	30
Hydrochloric acid	HCl	31
Hydrogen peroxide	H ₂ O ₂	32

1A.2 Particulate (Inorganic, Nonmetallic) Substances (40-49)

	Symbol	Position
Particulate Matter		
	Dust	40
	Soot	41
	Carbon dust	42
Particulate Inorganic Substances (Nonmetallic)		
	Ammonium	45
	Nitrate	46
	Sulphate	47

1A.3 Metals (50-69)

	Symbol	Position
Arsenic	As	50
Lead	Pb	51
Iron	Fe	52
Cadmium	Cd	53
Copper	Cu	54
Chromium	Cr	55
Mercury	Hg	56
Manganese	Mn	57
Nickel	Ni	58
Vanadium	V	59
Zinc	Zn	60

1A.4 Organic substances (not halogens) (70-179)

	Symbol	Position
Volatile organic substances	VOC	70
Total hydrocarbons	HC traffic	71
Alkanes		
	Alkanes	80
	Methane	81
	Ethane	82
	Propane	83
	Butane	84
Alkenes		
	Alkenes	90
	Ethene	91
	Propene	92
	Butene	93
Alkynes		
	Alkynes	100
	Acetylene	101
Aldehydes		
	Aldehydes	110
	Formaldehyde	111
	Acetaldehyde	112
	Butanal	113
	Benzaldehyde	114
Ketones		
	Ketones	120
	Acetone	121
Alcohols		
	Alcohols	125
	Methanol	126

	Ethanol	127
	Propanol	128
	Butanol	129
	Phenol	132
Glycols		
	Glycols	135
	Etheneglycol	136
	Propeneglycol	137
Aromatic Substances		
	Aromatics	140
	Benzene	141
(= methylbenzene)	Toluene	142
(= dimethylbenzene)	Xylene (total)	143
(= vinylbenzene)	Styrene	144
Toluenediisocyanater	TDI	145
Polycyclic Aromatic Compounds		
Polyaromatic compounds (PAH including substituted polyaromates)	PAC	150
Polyaromatic hydrocarbons (not substituted)	PAH	151
Nitric aromatic compounds	nitro-PAH	152
	Naphthalene	153
	Anthracene	154
	Phenantrene	155
Complex Solvents (Petroleum Based, not Chlorides)		
	Solvent HC total	160
	Benzine	161
	Petroleum spirit	162
	Vanolene	163
Naturally Emitted Hydrocarbons		
	VOC nat. total	170
	Isoprene	171
	Terpenes	172

1A.5 Halogenic Organic Substances (180-249)

	Symbol	Position
Chlorinated Solvents		
	Solvent Cl total	180
(= Dichloromethane)	Methylene Chloride	181
(= Trichloromethane)	Chloroform	182
(= CCl ₄)	Carbon tetrachloride	183
	Vinyl chloride	184
	1,2-Dichloroethane	185
	1,1,1-Trichloroethane	186
(= trichloroethylene, Tri)	Trichloroethene	187
(= Perchloroethylene)	Tetrachloroethene	188
Chlorine-Fluorine-Bromine-Alkanes		
Completely halogenated freons:		

Chlorinefluorinecarbons (total)	CFC total	190
(=R12)	CFC-11	191
	CFC-12	192
	CFC-113	193
	CFC-114	194
Incompletely halogenated CFCs: (Replacement for CFC - soft freons) (R22)	HCFC-22	200
Incompletely fluoridated CFCs: (C ₂ H ₂ F ₂)	HFC-134a	203
Bromium-chlorine-fluorine carbons (Halons): Completely halogenated halons (= CF ₂ ClBr) (= CF ₃ Br) (=C ₂ F ₂ Br ₂)	Halons total	210
	BCFC-1211	211
	BFC-1301	212
	BFC-2402	213
Incompletely halogenated halons (=CHF ₂ Br)	HBFC-22B1	215
Other halogenated organic substances (=1,1,1-trichloro-2-bis(4-chlorophenyl)ethane)	DDT	220
Chlordane	Chlordane	221
Polychlorinated biphenyls	PCB	222
Toxaphene	Toxaphene	223
Dioxines		
Polychlorinated dibenzo-p dioxines	PCDD	225
Polychlorinated dibenzo-furanes	PCDF	226
Brominated dioxines	Brom. dioxines	227
	TCDD	228
	Lindan	229

1A.6 Others (250-)

Number of vehicle kilometres	vekm	250
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Appendix 1B: Mathematical Definitions of the Formulae Used in the EDB

1B.1 Point, Area and Grid Source Emissions

In the Airviro EDB, emissions can be calculated as a function of the hour, day, weekday, month and as a function of the outdoor temperature. In order to identify non-working days when they appear in the middle of the week (e.g. when New Years Day appears on a Wednesday) the concept of day types is introduced, i.e.

Day type (index)	Meaning	Relative occurrence during a year
Monday-Thursday type (0)	Ordinary working day	4/7
Friday type (5)	Day before non working day	1/7
Saturday type (6)	Non working day - Saturday	1/7
Sunday type (7)	Non working day - Sunday	1/7

The following variables and functions are defined:

Dty	= day type index = {0,5,6,7}
w(dty)	= relative occurrence of day type dty
M	= index for month m= {1, 2, ..., 12}
W(m)	= relative occurrence of month m (approximated as 1/12)
H	= hour during the day = {1, 2, ..., 24}, e.g. h=12 corresponds to mean value between 11 and 12
S	= scenario index
T	= outdoor temperature = {T1-T2, T2-T3, ..., T29-T30}. By default -30°C < T < 30°C with a class width of 2°C.
W(T)	= relative occurrence of temperature interval T.
E ₀	= mean emission during the year (g/s)
E _{max}	= maximum emission at any hour during a year

$E(h,dty,m,s)$ = estimated emission for any hour, day-type and month for the scenario s

$TabS(s)$ is a table defining the variation with different scenarios and is not normalised.

$TabM(m)$, $TabD(dty,h)$ and $TabT(T)$ are the tables defined in the EDB Time and Temperature formulae giving the variation for months, for all hours and all day types and outdoor temperatures. $TabS(s)$ is the table defining the variation with scenario and is not normalised.

A normalisation constant k is calculated so that the following condition is fulfilled:

$$k \times \frac{1}{12} \sum_m TabM(m) \times \left\{ \frac{1}{24} \sum_h \sum_{dty} w(dty) \times TabD(dty,h) + \sum_T w(T) \times TabT(T) \right\} = 1 \quad (\text{eq B1.1})$$

The emission can be calculated in two different ways, i.e.:

$$E(h,dty,m,s) = E_0 \times TabS(s) \times k \times TabM(m) \times [TabD(dty,h) + TabT(T)] \quad (\text{eq B1.2})$$

$$E(h,dty,m,s) = TabS(s) \times E_{\max} \times Amp \quad (\text{eq B1.3})$$

$$\text{where } Amp = \frac{TabM(m) \times [TabD(dty,h) + TabT(T)]}{E_{\max}} \text{ if } Amp < 1 \text{ else } Amp = 1 \quad (\text{eq B1.4})$$

The difference between equation B1.2 and B1.3 will become obvious when you work with the formulae. Equation B1.3 represents an upper limit restricted emission, i.e. the maximum emission is E_{\max} for all hours during the year. If you describe the emission as originating from an oil-burning power plant, then the energy production rate and consequently the emissions would depend on the load. There is however an upper limit in the production rate, restricted by the maximum capacity of the boiler. *Equation B1.3 is used for the emission estimation in the EDB when you choose emission estimation based on **Fuel**.*

In equation B1.2 there is no such restriction. E_0 represents the total emission during a year if we convert the units from grams/second to tons/year. The factor k ensures that the mean emission from the source for the whole year is the figure E_0 . The figures in $TabM$, $TabD$ and $TabT$ just give the variation within the year. *Equation B1.2 is used for the emission estimation in the EDB when you choose emission estimation based on **Substances (or Substance group)** and yearly emission figures.*

Consequently, equation B1.2 permits the user to prescribe a scenario in which all pollutants coming from a source are concentrated to a few hours.

1B.2 Road Source Emissions

The following variables and functions are defined:

Dty	= day type index = {0,5,6,7}
w(dty)	= relative occurrence of day type dty
M	= index for month $m = \{1, 2, \dots, 12\}$
w(m)	= relative occurrence of month m (approximated as $1/12$)
H	= hour during the day = {1, 2, ..., 24}, e.g. h =12 corresponds to mean value between 11 and 12
S	= scenario index
L	= length of the road
N	= average number of vehicles per day on the road
corr	= correction factor for the road
E(speed,h,dty,m,s)	= estimated emission for any speed, hour, day-type and month for the scenario s
TabS(s,v)	Is the table defining the variation with different scenarios and is not normalised
TabR(speed,v)	Is the table defining the absolute emission from the vehicle with index v for different speeds.

TabM(m,v) and **TabD(dty,h,v)** are the tables defined in the formulae giving the variation for months, during the hours for all existing day types for a vehicle with index **v**. For each vehicle in a road type the normalisation constant **k(v)** is calculated so that the following condition is fulfilled:

$$k(v) \times \frac{1}{12} \sum_m TabM(m,v) \times \frac{1}{24} \sum_h \sum_{dty} w(dty) \times TabD(dty,h,v) = 1 \quad (\text{eq B2.1})$$

The emission for a road is then calculated as:

$$E(\text{speed}, h, \text{dty}, m, s) = \text{corr} \times n \times 1 \times \sum_v (TabS(s,v)) TabR(\text{speed}, v) \times k(v) TabM(m,v) \times TabD(dty, h, v) \quad (\text{eq B2.2})$$

1B.3 Normalisation of Formulae in an EDB

Normalisation is needed whenever emission data is given as a total yearly emission, that is for substance groups, substances emitted from point and area sources and for traffic exhaust emissions. The normalisation guarantees that the yearly emission will always be

exactly the one specified, in spite of emission variations in time and as a function of temperature.

In the EDB calculations the following approximations are made:

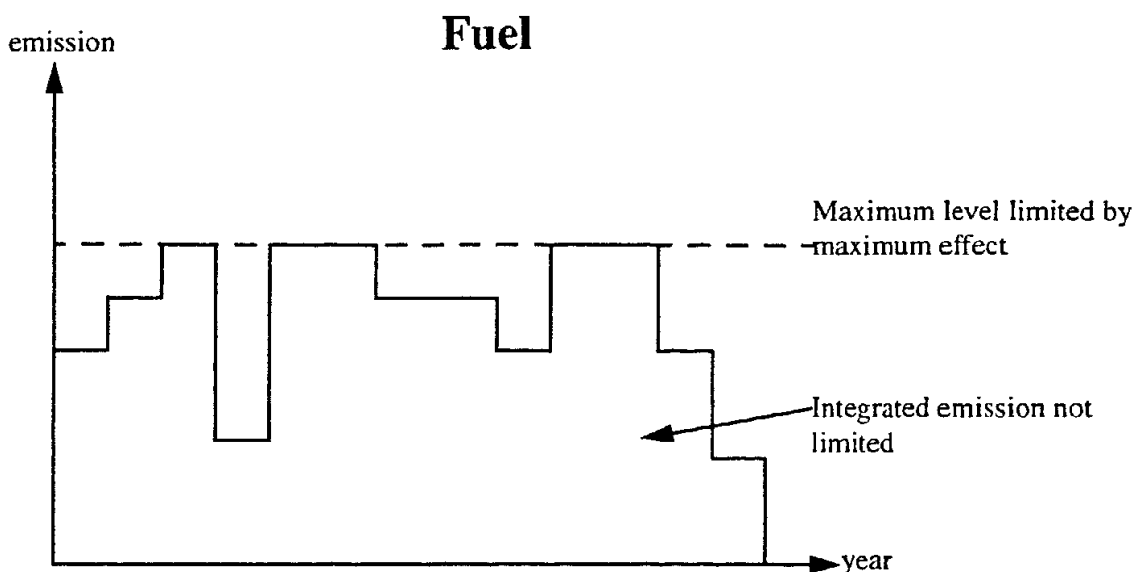
- 1 Year = 360 days
- 1 Month = 30 days
- Mon-Thu This day type is weighted with 4/7
- Fri, Sat, Sun These day types are each weighted with 1/7

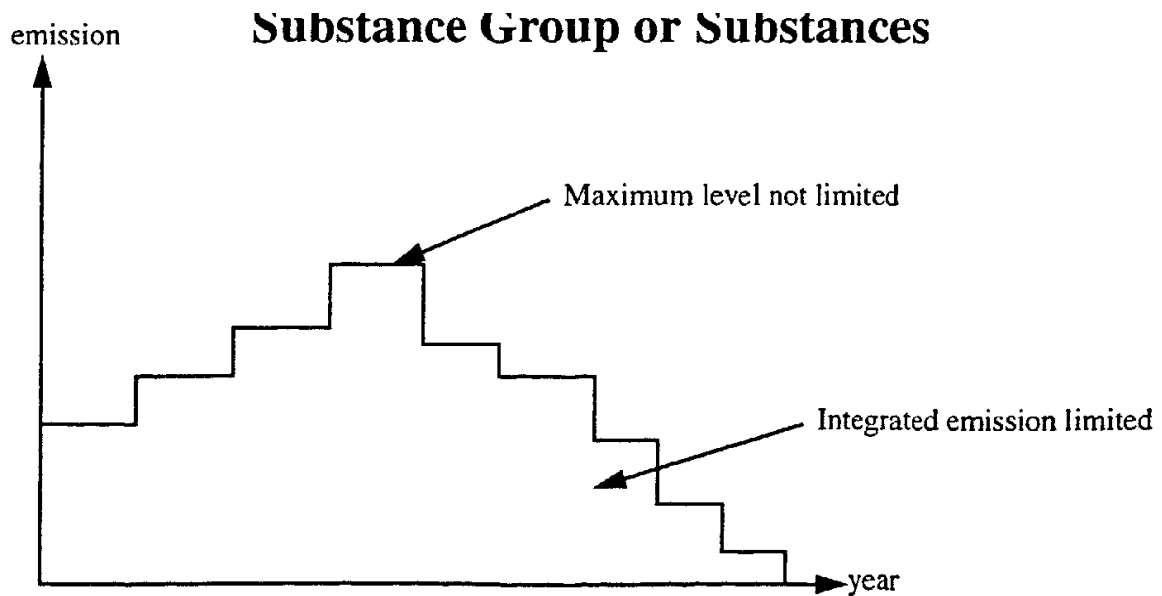
1B.3.1 Sources where the emission variation is not dependent on ambient air temperature variations

A total average emission E_0 is given for the whole year. If the emission is emitted evenly throughout the whole year then the emission per second will be E_0 . However if the emission is emitted evenly for just 12 hours every day then the emission for those hours will be twice as much while the emission outside those hours will be zero.

1B.3.2 Sources where the emission variation depends only on ambient air temperature

In principle it is possible to combine both time and temperature dependence in the normalisation formula, but the output would be very difficult to interpret. So unless you have very good reasons use either the time or temperature variation to characterise this type of emission variation. Note the difference between the ways in which the yearly emission is specified if you choose fuels (based on maximum effect) and if you choose substance groups or substances (based on yearly average emission).





The most common emission specification is the second case where a yearly average emission is specified. In order to be able to normalise the temperature dependence we need to know the temperature distribution during a year. Within Airviro there is the possibility of configuring databases for statistical data such as climatological temperature distributions during a normal year, normal months and normal hours. The distributions are given as percentage values so that each distribution adds up to 100%. If the temperature database has not been configured then the default temperature database will be used which is based on temperature data from Göteborg. If you do not want to use a temperature distribution from Göteborg then it is possible to type in a distribution by hand in the **Search** subwindow.

1B.3.3 Emissions described by maximum effects (fuels)

In this case there will be no normalisation. All variations specified in the tables will be interpreted as absolute percentage values and the emission can never be higher than the limit given by the maximum effect.

Appendix 1C: Structure of an EDB

