This document contains the help texts for OML-Multi.
Latest revised: December 1, 2005.

Contents

Getting started with OML

You can get started in either of the following ways:

Getting started with OML - the principles

Getting started with OML: Hands on

or go to

Contents of the help text - an overview

Getting started with OML: The principles

See also Getting started with OML: Hands on

The steps to go through when performing calculations with the OML model are in principle the following:

Input data

The model requires input data in order to compute concentrations of pollutants. The necessary input data are:

- information about emission;
- information about receptors (points for which calculations are made) and about the terrain;
- meteorological input. Danish users will typically not need to worry about this, because the model is bundled with a standard set of data which is normally used for regulatory purposes (stack height determination) in Denmark. This is a meteorological time series with one year's worth of data (from the airport of Kastrup).
  Users outside of Denmark will need a pre-processed meteorological data set representing local conditions. See Meteorological data

Using the menus

Most often, the menus are used in a sequence from the left towards the right.

- The user must choose a project name (via the **Files** menu). The name can refer to a new project or an existing project.
- He must enter input data (the menus **Sources** and **Receptors**).
- He can then carry out a set of computations, typically for a period of one year (the menu **Calculations**).
- As output, the model generates tables of concentration values. The **Results** menu is used to specify which types of concentration values the user wishes to see. This may be parameters related to EU limit values such as the 19th highest hourly concentration, or it can be the maximum of monthly 99-percentiles. The latter is a Danish limit value is used in the context of the Danish air emissions guide (Danish air emissions guidelines.)

There is extensive help throughout the program. If you wish an overview of all help texts, the click the button

in the menu bar (or here).

Advice about calculation strategy

In the context of Danish regulations (Danish air emissions guidelines), one is frequently confronted with the task of determining a stack height which complies with the C value. In this case, the following approach is recommended:

- Guess a stack height, and perform computations for one year..
- If you wish to reduce computation time, then take note of the month with the highest monthly 99-percentile.
- Make a new guess and perform a set of computations for the relevant month only.
- Repeat the calculations with more guesses for stack height, until a suitable stack height has been found.
- Use this height to make a computation for an entire year, in order to check whether the C value is complied with for all months of the year.

Of course, if a set of yearly computations lasts only a couple of seconds, one may run through an entire year of calculations for each guess.

See also Getting started with OML: Hands on

Getting started with OML: Hands on

See also Getting started with OML: The principles

The steps in performing a set of computations can be outlined as follows:

- Start OML-Multi by double-clicking the OML-Multi icon on the Desktop.
- Select **Files|New project** . If you are not in the folder where you wish to save your project data, you should navigate there by using the folder tree in the right panel.
  For *Project name* enter *Test* and click *OK*.
  This will lead you to the window *File names assigned to the project*. Here, you can just accept the names suggested and click *Save project.* This will save *the names* of the project files, but the files do not yet exist. Visually, this is indicated by grey - not black - file names.

You must now enter source data and receptor data (in any order) before you can make a set of calculations.

- Select **Sources**. and then *Point sources*.
  You may enter comments for the source for your own internal use (shown on-screen only). Then, fill in the remaining source data. You can move from field to field by using the *Tab* or the *Enter* key.
  Use the *Help* button to get help when you fill in the various fields.
  One of the more difficult issues in practical applications of OML-Multi is the specification of building data. Here, you may seek guidance in a separate note: "Handling the influence of buildings in the OML model".
  When you're done use *Save all sources*
  Click *Yes* to leave the sources menu.
- Select **Receptors**. This allows you to specify the receptor grid (points where calculations are made), both in respect to position and to the terrain characteristics. You can choose either to use a circular or a rectangular receptor grid. You can enter your own data, or accept some or all of the default values.
  Use the *Help* button to get help for the various fields.
  When you're done use *Save.*
- Select **Calculations**.
- Then click *Save* and confirm with *Yes* that you wish to continue with the calculations..
  When the calculations are over you will get an on-screen message.
  Close the message. The button **Results** leads you to a window, where you can choose the extent of the results you wish to see. You may also chose to see the results visualised in a simple graphical format.
  See also Interpretation of model output

There is extensive help throughout the program. If you wish an overview of all help texts, the click the button

in the menu bar (or here).

See also:

Getting started with OML: The principles
Sample files, overview

Meteorological data

Danish users will typically not need to worry about meteorological data, because the OML model comes bundled with a standard set of data. This standard set is normally used for regulatory purposes (stack height determination) in Denmark. The set is a meteorological time series with one year's worth of data (from the airport of Kastrup).

Users outside of Denmark will need a pre-processed meteorological data set representing local conditions. Typically, hourly data are required for a period of one year to perform realistic calculations.

International users may find relevant data sets in the folder Met_data on the installation CD. For instance, registered users in Latvia will find a data set from Riga in that folder.

In order to use such additional meteorological data sets, the data should be manually copied to your hard disk; you may put them anywhere on your disk, but the suggested location is in the folder C:\OML_data.

If you use other meteorological data than the standard data set supplied with the model, then you must make sure that the settings within the "Special settings" menu are correct. Especially, check the settings for *Resolution of wind direction* and the *Meteorological year.* See the section "Special settings" for details.

Note that with version 5.0 of OML-Multi (October 2002) the format of meteorological data has changed. See New format for meteorological data.

If you do not have a relevant meteorological data set, such data can be generated with the *OML meteorological pre-processor*, using measured meteorological data as input. This pre-processor is not included on the OML-Multi CD, but is available free of charge on request. You may also request a separate guide to the preprocessor: *Using the OML meteorological preprocessor - a practical guide*. However, running the preprocessor is a specialised and quite demanding task.

See also:

New format for the meteorological file
Resolution of wind direction data.

Using the menus

File names assigned to the project

See also: New project | Open project | Save project as | Copy Files | File types

The menu **Files | Files in current project** will lead you to the window ***File names assigned to the project.***

A project comprises the entire set of files required for the computations, as well as files with results.

A project is created as soon as you have been through the menu **Files | New project** and indicated a project name.

At first, a new project is "empty". A name has been defined for the files belonging to the project, but the files do not yet exist.

The window *File names assigned to the project*

In the window ***File names assigned to the project*** names of existing files are black, while names of non-existing files are grey.

By *clicking a file name* you get the opportunity to change the files in use, to copy data etc.

Note that you have to click on the *file name itself*, not just on the empty space in the fields.

Use *Shift+Click* to find out when a file was last modified..

Description of some typical tasks:

- You wish to create a new project from scratch:
- You just want to use an existing project:
- You wish to create a new project, but base it on an existing:
- You have moved all files in a project to a new folder and wish to use them there.

Recipe: New project from scratch

Click on the project name and choose the fourth option: Create a new project containing new files.

Alternatively: Go through the menu **Files | New project**.

Recipe: Choosing an existing project

An existing project can be selected by the menu **Files | Open project,** where the project name is selected.

A hint: If you wish to get hold of your most recent project, you can just select **Files | Files in current project** - or, even simpler: press **Ctrl+F**

The lowest part of the drop-down menu **Files** contains a list of the 9 most recent files.

Recipe: new project based on an existing

In the window ***File names assigned to the project*** click on the project name and select the third option:

Save the project and data under another project name and file name.

Alternatively: Go through the menu **Files | Save project as**.

Recipe: Files have been moved

See also: File names assigned to the project | New project | Open project | Save project as | Copy Files | File types

If you have copied or moved all files belonging to a project to a new folder, you will have to spend a few mouse clicks before you can use them.

Assume that you have a project called Example.prj, and the files belonging to it all are called something with Example.

If you open the project Example.prj, it will refer to the *previous location* of the files.

This can be easily changed. Press the button **Common names** and navigate to the folder where you have placed the files.
Then assign the common name Example to all of the used files.

Common names

See also: File names assigned to the project | New project | Open project | Save project as | Copy files | File types

The button **Common names** in the window ***File names assigned to the project*** allows you to assign a common name to all files in a project (except for the meteorology file).

This button is useful if you have moved all files belonging to a certain project from one folder to another.

See also: Recipe: Files have been moved

New project

See also: File names assigned to the project | Open project | Save project as | Copy files | File types

A project comprises the entire set of files required for the computations, as well as files with results.

At first, a new project is "empty" in the sense that a name has been defined for the files belonging to the project, but the files do not yet exist.

In the window ***Enter new project name*** you must enter a new project name before clicking OK.

Instead of creating a new project from scratch, you may base it on an existing project.

Open project

See also: File names assigned to the project | New project | Save project as | Copy files | File types

A project comprises the entire set of files required for the computations, as well as files with results.

The menu **Files | Open project** leads you to the window File names assigned to the project

A standard installation creates the folder **C:\OML_data**. This folder is a good place to save your own project data.

Save project as

See also: File names assigned to the project | New project | Open project | Copy files | File types

When you choose **"Save project as.."** (through the **Files** menu) you have two options:

- Either *just to change the **project name*** (while nothing happens to the data files you use; they retain their original name).

or

- to *copy the relevant files* (project file and data files) to a set of files with a new name.

Especially the last option is useful, if you wish to base a new project on an existing.

See also File names assigned to the project

Copy files

See also: File names assigned to the project | New project | Open project | Save project as | File types

In order to copy files you must open the window File names assigned to the project .

Click on a file name. A menu pops up, where one of the available options is file copying.

The details of copying are different, depending on whether you clicked a project name or clicked another file name

Hints

1. If you have used Windows Explorer to move all files belonging to a certain project from one folder to another, you must spend a few mouse clicks before you can use the files.The procedure is explained in the topic: Recipe: Files have been moved

2. If you wish to copy all files from an existing project, then use Save project as

Copying by clicking a project name

A dialog box allows you to copy all files from a different project to the current project.

The file with input meteorology is an exception. It will not be copied.

Hint:

If you get the message **"No files to copy !!!**" it may be because the project you wish to copy from isn't consistent.

Chances are that the project file refers to some files which are not found in the expected locations.

In this situation follow the advice in the topic **Recipe: Files have been moved**.

Copying by clicking a file name

A dialog box allows you to copy data from a file to the current file.

The source file must be of the same type as the current file.

However, files of the types .kld and .kbg (data for point sources) go together: If you accept to copy from a .kld file, data from the corresponding .kbg file will also be copied.

Sources menu

The **Sources** menu leads you to the following windows:

- Point sources
- Area sources
- Background levels
- Import point sources
- Import area sources

Go to Contents

Point sources window

See also: Sources menu I Source geometry I Emission I Buildings

The **Sources** drop-down menu gives access to the screen ***Point sources, constant emission***

OML-Multi accepts a maximum of 3000 point sources.

There is a maximum of 3 substances. Tip.

There are separate help screens for the 3 main sections of the ***Point Sources*** window:

- Source geometry)
- Emission
- Buildings

while some additional comments are given below.

Internal comments concerning the source

Comments entered in this field will only be shown on the screen. On the other hand, the *text for source identification* (max. 8 characters) will be printed with the model results.

Note that you can also make comments concerning *the entire calculation* elsewhere - through the ***Calculations*** menu.

Settings

Use the Settings button if you wish to change your default units in the future.

More sources

There is a group of buttons to create new sources, delete sources and change the order of sources.

The buttons with arrows are used to select another source.

Time variation

You can specify a regular time variation of emission rate by specifying factors for month, day of week and hour. The emission is multiplied by these factors.

None of these factors may be larger than 9.99.

See also Time variation of emission

If you wish to work with an emission pattern which is not regular, but where you know the emission hour by hour, you can choose to work with a Time series of emission data (only for point sources).

Note for Danish users:

Calculations with time variation are of interest when mapping air pollution, but according to the Danish air emissions guidelines time variation should be disregarded when determining stack heights (see section 3.1.8 concerning C-value by intermittent operation).

Keys

In order to move from one field to the next, you can either use the Tab key or <Enter>. (Shift+Tab brings you a step back)

You can enter the ***Decimal symbol*** either as a comma (,) or as a point. It is shown on screen as point..

Source geometry

Sources menu > Point sources window > Source geometry. **See also:** Emission | Buildings

Point sources window: Source geometry

The section ***Source geometry*** is one of three main sections in the Point Sources window.

- *Optional text for source identification:* You may indicate a short (max. 8 characters) identification of the source, which will be printed with the model results.
- *X and Y co-ordinates:* You can define your own co-ordinate system - e.g. with origin in one of the sources - or use a standard co-ordinate system such as UTM. The X axis must point toward the East and the Y axis towards the North..See: Co-ordinate system
- *Terrain height* The terrain height at the base of the stack. You can choose your reference level as you please. For flat terrain it will be simplest to use the height 0 for all sources and receptors. You might also use height above sea level.
  As a consequence of the free choice of reference level, negative heights are perfectly acceptable.
  See also: Terrain effect
- *Stack height (height above surface):* height of the stack top above the terrain.
- *Inner diameter of stack top:* Inner stack diameter at the point of release. If two or more smoke pipes are led to the top of the same stack, it may be most correct to combine the sources computationally, and provide an ***effective inner stack diameter*** as input to the model. For more details see: When can two sources be counted as one?
- *Outer diameter of stack top*: Outer diameter of the stack at the point of release (for vertical stacks). This value has implications for computation of stack downwash..

- *Horizontal outlet (no vertical momentum)*: Normally, this box should not be checked. It should only be checked if the gas has negligible vertical velocity. See Plume rise

Emission

Sources menu > Point sources window > Emission. **See also:** Source geometry | Buildings

Point sources window: Emission

The section ***Emission*** is one of three main sections in the Point Sources window. Here you can enter information about the pollution emitted..

- *Emission rates:* Make yourself clear how you know the emission. This determines the most convenient way for you to pass the information on to the model. You can choose between two fundamentally different types of *units for emission*:
  emitted amount per time unit
  or
  emitted amount per Normal cubic meter gas.
  Select the unit in the field at the far right. The first 4 options in the drop-down list refer to amount per time unit, while the fifth, *mg/Nm3* is of a different kind, because it refers to emitted amount ***per Normal cubic meter gas***.
  If odour is the problem and the emission strength is known in odour units per second, Danish practice is to use a correction factor of 7.8 for the emission. See more about odour...
  When you have selected a unit, you must enter a value for the emission rate. According to the Danish regulations (Danish air emissions guidelines), the emission rate should be indicated as maximum hourly rate.
  If you have several sources, you may use different units for the different sources.
  In the printed output from OML-Multi, concentrations are always given in the unit *µg/m3*. If this leads to very large or very small values, it is recommended to change the format for printing results to exponential format. This is done from the window Special settings
- *The button Time variation*
- *(substance) Names:* You may specify a short name with no more than 6 characters..
- *Temperature:* the gas temperature at the top of the stack. Select unit in the field at the far right.
- *Volume flux:* is indicated as the total (including water vapour) volume flux of gas in the unit selected in the field at the right. **Nm3** implies that the volume flux is given at a temperature of 0 °C, while **m3** implies that the volume flux is given at the actual temperature.
  Note on water vapour content: If you do not know the total volume flux, but the flux of *dry gas* and the *humidity content*, then you yourself must calculate the *total volume flux*. See "Total volume flux".

Which emission value should be used?

See also: Emission

The following concern Danish regulations

If you conduct a stack height determination according to the Danish regulations (Danish air emissions guidelines), the basis for the computations is the source strength G.

Basically, the source strength G is the maximum permissible emission of a given substance during one hour of operation, measured as mg/sec. G should be determined by means of one of the following approaches:

1. G may be determined on the basis of the limit value for emissions laid down in the terms of the relevant approval for the outlet in question, and on the basis of the maximum hourly flow rate during operation. G is calculated by multiplying the limit value for emissions, mg/normal m3, set in the approval with the maximum flow rate in the outlet measured in normal m3/sec.
2. In cases where no limit value for emissions has been set, the maximum hourly emission during normal operation is used instead. In several cases, for example, G may be determined on the basis of the amount of paint used at a surface-treatment plant, where all organic solvents are normally emitted into the atmosphere. The maximum hourly consumption will then form the basis for calculations of source strength.
3. Where devices intended to reduce pollution have been installed, and these devices mean that emissions from the installation in question are significantly lower than the limit values for emissions laid down in the Guidelines, the actual emissions may be used when calculating outlet heights, if a maximum

hourly emission can be determined on the basis of the figures available on actual emissions. The approving authority and the relevant installation should consider whether the emission limits should be reduced instead.

Definition of humidity percentage

See also: Emission | Total volume flux | Conversion equation

Humidity percentages for gas emissions can normally be understood as the fraction of water vapour relative to the total volume (Vol% H2O).
(Humidity indicated as *relative humidity* is something completely different, involving the question of how much humidity air at a given temperature can accommodate).

However, certain measuring methods for determining water content yield as their result the ratio of water vapour relative to the *dry air volume*. Such results should be converted and expressed in terms of Vol% H20 before being used in the equation for converting dry to wet volume flux.

Thus, we have the following two concepts:

Vol% H2O = volume percentage of water vapour relative to total amount of humid gas.

Vol%H2O (dry) = volume percentage of water vapour relative to amount of dry gas.

Their relation is:

Vol% H2O = Vol% H2O(dry) * 100 / (100 + Vol% H2O(dry)).

Conversion equation: Dry to wet volume flux

See also: Emission | Definition of humidity percentage | Total volume flux

Conversion from dry to humid volume flux

The definition of humidity percentage in air as used in context of OML, expresses the ratio of water vapour to the total volume (volume H2O / total volume of air, including water vapour). Conversion between total volume and dry volume takes place according the equation below:

$$Q_{humid} = Q_{dry} \frac{100}{100 - H_2O\%}$$

where Q_{humid} = total flux of humid gas (m^3/hour)

Q_{dry} = flux of dry gas (m^3/hour)

H_2O % = volume percentage of water vapour in terms of total amount of humid gas (Vol%).

Total volume flux

See also: Emission | Conversion equation | Definition of humidity percentage

The total volume flux is the sum of dry gas and water vapour.

If you do not know the total volume flux, but the flux of *dry gas* and the *humidity content in vol%*, then you yourself must calculate the ***total volume flux*.**

An example:
The volume flux of dry gas is 8 m3/s, and the humidity is 20 vol%H2O. The total volume flux is then 10 m3/s.
See also Conversion equation: Dry to wet volume flux and Definition of humidity percentage.

The humidity content in combustion gas depends on the process in question and the type of fuel. The

humidity corresponds to the sum of water originating from the air used for combustion, and the water generated in the combustion process. Typical values for humidity content are 10% (vol) for oil and 7% (vol) for coal.

Time variation of emission

You may define time variations for both point sources and area sources.

In both the ***Point sources*** window and in the ***Area sources*** window there is a button labelled **Time variation** (below the value of the emission rate), which allows you to define a time variation for the emission.

The variation is defined on a basis of month, day of week, and hour of day. The time variation thus defines a ***regular pattern*** for the emission.

Note: If the pattern of emission isn't regular, but you know the emission hour by hour, you should use a different feature: You can specify a complete Time series of emission data for all hours (this applies only to point sources).

Factors for regular patterns:

In order to specify a regular time variation, you must define weighting factors that are applied to the emission rates you have previously specified.

None of these factors are allowed to exceed 9.99

At the bottom of the screen you will find information on the maximum emission rate and on the total yearly emission.

See also
Point sources window, emission
Area sources window
Types of time variation (area sources)
Special settings (Settings concerning daylight saving time)
Time series, emission data (for point sources)

When can two sources be counted as one?

Point sources window > Source geometry > Addition of sources. See also: Source geometry

Addition of stacks or smoke pipes.

Calculations for two or more stacks or smoke pipes located very close to each other can always be performed as if the stacks were separate. However, it sometimes makes sense to (computationally) combine stacks or smoke pipes if it can be assumed that the plumes ***actually do merge***. This method makes use of an ***effective diameter***.

The details are as follow:

When smoke pipes are located very close to each other - for example when several pipes are led to the top of the same stack - it is most correct in the calculations to consider the pipes as one pipe: add emissions and volume fluxes, respectively, and compute an effective (fictive) inner stack diameter (for details see below). The underlying assumption is that the plumes from the smoke pipes merge immediately after leaving the stack top. The plume rise of a merged plume is greater than that of individual plumes.

The requirement for adding plumes in this manner is that the sources are similar with respect to stack height, gas temperature and gas exit velocity. Furthermore, the smoke pipes should be situated quite close to one another - as a rule-of-thumb they should not be separated by more than one inner (pipe) diameter.

In such cases an ***effective inner stack diameter*** should be estimated and supplied as input to the model according to the equation:

$$d_{eff} = \sqrt{\sum_i d_i^2}$$

where

d_i

is the inner diameter of smoke pipe number i. The volume flux and the emission inputted to the model should be the sum from all pipes added together.

Buildings

Sources menu > Point sources window > Buildings. **See also:** Source geometry | Emission

Point sources window: Buildings

The section ***Buildings*** is one of three main sections in the Point Sources window. Here you can enter information about buildings which may affect the dispersion.

- *General effective building height* Crudely speaking, this is the height of a building which is placed under the source or right next to it. Note however, that the value to be entered is an "effective height". For narrow buildings the effective height is less than the physical height. See Building effect
- *Directional dependent building data.* The button **Enter data** allows you to specify data for a direction-dependent building effect:
  See Building effect and Direction-dependent building effect: Entering data

See also the note "Handling the influence of buildings in the OML model".

Building effect

See also: Point sources window | Buildings | Direction-dependent building effect: Entering data

Note: For an explanation of how you should prepare building information for the OML model it is recommended that you read the note "Handling the influence of buildings in the OML model".

For help to the window **Directional dependent building data**: See Direction-dependent building effect: Entering data

Below, the following topics are explained:

Why consider building effects?

Two types of building effects

Effective building height

When can building effects be disregarded?

General building effect

Direction-dependent building effect

Why consider building effects?

Buildings, which are located near a stack, may have a large influence on the pollution concentrations in the surroundings. This is due to the fact that buildings may lead to the creation of a flow field, which can both restrain the lift of the plume and increase the dispersion of the plume; these effects may have consequences for the concentration at all distances from the source.

In order to quantify these effects, the OML model requires information on buildings close to the stack.

(Buildings may also be of interest in a completely different context: You may wish to determine the exposure of persons in a tall building In that case, you should specify an appropriate receptor height for relevant receptors. See Receptor heights window)

Two types of building effects

Building effects can be categorised in two types:

The ***general building effect***, expressed by a building height, is used when a building is placed quite

close to a source.

The ***direction-dependent building effect*** is relevant if a building is located at some distance from the source, but still close enough to exert a considerable influence on the flow.. If a building is more than two building heights away from the stack, it can be disregarded.

Both types of building effects can occur simultaneously.

Specification of building data is one of the more difficult tasks in practical applications of the OML model. Here, you will find a brief explanation of the main concepts. However **it is recommended that you read the note "Handling the influence of buildings in the OML model".**

Effective building height

For 'narrow' buildings you should be aware that you should specify the so-called *"effective building height"* - not the physical building height. A building is considered 'narrow' if it has a height larger than its width. The concept of an effective building height is used both in the context of *general building effect* and in the context of *direction-dependent building effect.*

When can building effects be disregarded?

When preparing to specify building data, it is recommended that you start by drawing a draft map of the stack(s) and nearby buildings. In the first phase, don't use a computer but just pencil and paper, a ruler and possibly an angle meter.

All of the following criteria must be fulfilled - otherwise the building can be disregarded (HB is the Effective building height"):

- Is (the closest part of) the building closer than 2 HB?
- Is the building (HB) higher than 1/3 of the stack height?
- As seen from the stack, does the building occupy an angle of more than 5 degrees?

General building effect

In OML, the presence of a general building effect is specified by indicating the height of the building in the window ***Point sources*** in the field *General building height*. The building effect is considered to be general if the building is located juxtaposed to the source, or if it is placed quite close to the source and - seen from the source - it occupies an angle of 90 degrees or more. Note that for narrow buildings the so-called "effective building height" may be used instead of the physical height.

Direction-dependent building effect

Direction-dependent building effect is applied for buildings at some distance from the source. If a building is farther away from the source than two building heights, it can be disregarded. See Direction-dependent building effect: Entering data

See also Point sources window (concerning the window ***Point sources***).

Go to top of this page (Building effect)

Direction-dependent building effect: Entering data

See also: Point sources window | Buildings | Building effect

Note: For an explanation of how you should prepare building information for the OML model it is recommended that you read the note "Handling the influence of buildings in the OML model".

Direction-dependent building effect is relevant for buildings located at some distance from the source.

If a building is farther away from the souce than two building heights, it can be disregarded

In order to be able to enter direction-dependent building data, in the window ***Point sources*** you should click the button *Enter data*.

You must specify the direction to the building, its effective height, and its distance from the source.

You cannot specify the presence of more than one building in a given direction. If there is more than one building in a particular direction, you should indicate data for the dominant building.

For each direction indicate

Effective height and *Distance*

Directions are indicated in tens of degrees, counted from the North, and have values between 10 and 360

degrees. Thus, "90" means East and "360" North.

Angles are rounded in the following way:

If the user specifies that there is a building in the direction 10 degrees, the programme assumes that there is a building in the angular section 5 to 15 degrees. If the building extends into an angular section around a certain direction (and not only touches the section slightly), then that direction should be included.

- *Effective height* is the effective building height.
- *Distance* is distance from the source to the closest point of the building.

Effective building height

For 'narrow' buildings, instead of the physical building height you should use and effective height *HB* defined by

$$HB = \frac{HF + 2L}{3}$$

where *HF* is the physical building height, and *L* the width of the building. See the note *Handling the influence of buildings in the OML model* for more details.

(The note is available through the Help system.)

Note on handling of building effects

The note *"Handling the influence of buildings in the OML model"* accompanies OML-Multi 5.0.

It is an electronic file in PDF format.

You may open the note here (if you have installed the free program Acrobat Reader).

Plume rise

In the window ***Point sources***, the box *Horizontal outlet (no vertical momentum)* should normally be left unchecked.

This option can be applied in order to get a realistic treatment of sources with a "cap" and of sources with a horizontal outlet - i.e, ***outlets, where the gas does not have a vertical velocity.***.

Normally, a plume rises because of two mechanisms:

1) Often, the plume is warmer than the surrounding air (*thermal plume rise*)

2) It has an upward velocity (*mechanical plume rise*)

The option *Horizontal outlet (no vertical momentum).* allows the user to discard the *mechanical plume rise*, while thermal plume rise always is taken into account.

Normally, the OML model assumes that the flow occurs through a vertical outlet with no obstacles. If this requirement isn't fulfilled, you should check the box *Horizontal outlet (no vertical momentum).* In that case, a vertical velocity of zero is assumed.

See also Source geometry

Stack downwash

An effect that reduces the effective plume height.

On the leeward side of a stack the pressure will be slightly reduced, causing the downwash. The magnitude of effect depends on outer stack diameter, and on the ratio between plume exit velocity and the wind velocity. The effect is most severe for thick stacks with low exit velocity.

For horisontal outlets on the side of a building, the stack downwash will be neglegible compared to building downwash.

Odour

See also: Odour: Flowchart for procedure

The description below of a procedure for handling problems involving odour is based on the Danish guidelines (Danish air emissions guidelines, section 4.5) from 2002. It is likely that this procedure will be altered in future, when a separate set of guidelines for odour become published.

The OML model computes monthly 99 percent fractiles of *hourly averaged concentrations.*

When odour concentrations are evaluated, the relevant averaging period is on the order of 1 minute (not one hour). The method to achieve a conversion, as prescribed in the guidelines, is to multiply the source strength by a factor of 7.8. (7.8 is the square root of 60, corresponding to the ratio between 60 minutes and 1 minute).

In practice, the user should multiply the emission in Odour Units (OU) by 7.8 and insert this value for emission. Note, however, that the unit (in the ***Source*** window) should be indicated as *microgram/s*.

In this way, the calculation result in the tables will be in OU/m3 (even though the unit in the tables is labelled mikrogram/m3).

The 99 percentiles computed in this manner should be compared to a limit value of 5-10 OU/m3 (odour units/m3).

The Danish air emissions guidelines mention a factor of 1 million in relation to odour emission. The context where this factor is relevant is explained in the topic Odour: Flowchart for procedure

The entire question of computations for evaluation of odour problems is treated in a report (in Danish) - see the topic Odour: Technical report

Odour: Technical report

The current Danish procedure for evaluation of odour problems is described under the topic Odour.

However, as part of the preparations for a new set of guidelines specifically for odour, a study has been conducted at NERI, resulting in a report in Danish entitled **Konsekvenser af ny beregningsmetode for skorstenshøjder ved lugtemission** (*Heights of odour emitting stacks - consequences of the introduction of a new calculation procedure*).

The procedures described in the report have not yet been implemented in the standard version of OML-Multi (as of November 2003).

The report contains an English summary, and it is available on the Internet.

The bibliographic information for the report is:
Løfstrøm, P.(2000): *Konsekvenser af ny beregningsmetode for skorstenshøjder ved lugtemission*. Danmarks Miljøundersøgelser. 66 s. - Technical report from NERI, no. 327 (online).
The report can be found through *http://faglige-rapporter.dmu.dk*
or directly at

http://www.dmu.dk/1_viden/2_Publikationer/3_fagrapporter/abstrakter/abs_327_dk.asp

Odour: Flowchart for procedure

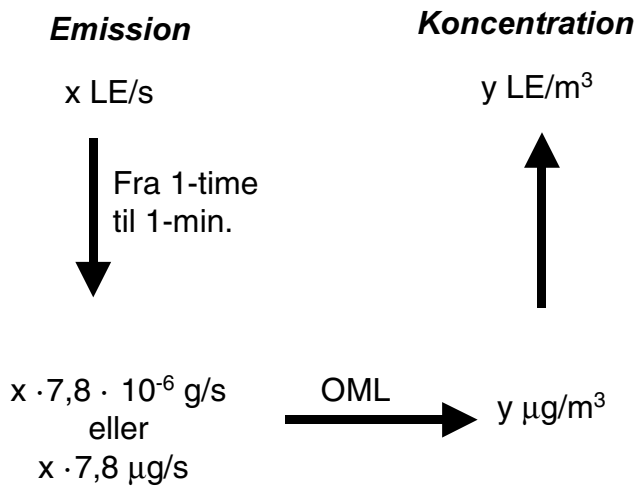
See also: Odour

In the Danish air emissions guidelines it is prescribed that source strength should be multiplied by 7.8 and divided by one million when assessing odour load with OML..

It is assumed that the source strength is known in units of odour units per second (OU/s).

However, the division by one million is only appropriate if one uses the unit g/s for the emission.

An outline of the procedure is given below:



Settings for point sources

The **Point sources window** contains the **Settings** button.

It leads to a window where you can control *default settings concerning emission*.

There is a different window to define 'Special settings' related to various aspects of *the current project*.

Units

In the ***Settings*** menu you can choose the units you wish to use in future projects.

Don't change units halfway in a project, when you have created some sources and wish to add some extra sources later.

Warnings

By default, OML-Multi will warn you if your data imply an extremely high or low gas exit velocity, or an extreme gas temperature. You may disable this warning through the Settings menu.

A warning is triggered by any of the following conditions:

- The exit velocity is smaller than 1 m/s or larger than 30 m/s.
- The gas temperature is smaller than 0 degrees Celsius or larger than 250 degrees.

Area sources window

See also: Sources menu | Point sources window

The menu **Sources|Area sources** gives access to the window ***Area sources***

Examples of applications where area sources are used: emission from a storage basin; emission from an area where several small sources are evenly distributed.

The shape of each area source must be approximated by a rectangles or squares; an area source may be rotated at any angle with respect to North.

The ***Area sources window***:

When you enter the window, you can enter data for the first source. When the first source is ready, additional sources can be added by using the **Insert** button.

Only sources with black text are included when you press **Save all.**

- *No* Internal number
- *ID* You may indicate a short (max. 8 characters) identification of the source, which will be printed with the model results.
- *Westerly corner* Enter coordinates for the most westerly corner of the area source.
- *Side lengths* Enter side lengths for the source. From the westerly corner, go along the circumference of the rectangle in a clockwise direction. You will first meet "Side 1", then "Side 2".
- *Angle* The angle between North and Side 1, positive in a clockwise direction (a number between 0 and 90).

- *Heights, Source* Average source height for the area source
- *Heights, Build.* Average building height for the area source
- *Emission rate* Total emission for the area source in g/s. Note that even if you can only see 4 decimals when you start entering a number, it is possible to enter emissions as low as 0.00000001 g/s and as high as 999999999 g/s. In the printed output the numbers are presented in exponential format with 3-5 significant digits.
- *Time var. type* A number between 1 and 5. Refers to user-defined types of time variations. These types can be defined through the button **Time variation.** If you don't explicitly define anything, you will use a time variation of "Type 1", and it will represent a constant emission.
- *The button **Time variation....***leads to the Edit time variation window, where time variations can be defined on a monthly basis, a weekly basis, and an hourly basis.

The treatment of area sources has been improved substantially in OML-Multi 5.0 compared to the earlier version 4.2. Therefore, calculation results for area sources may be different for the two versions.

Types of time variation (area sources)

For area sources, you may define up to 5 different types of time variation. Thus, you may have 5 different patterns describing how the emission varies with hour of day, day of week, and month.

If you don't define anything, by default you will use a "pattern" with a constant emission

For point sources things are a bit different: You are not limited to 5 patterns for all sources, because you can define an individual pattern for every single source.

A typical use of area sources is for calculation of air quality for urban areas. In urban areas there are frequently several hundred area sources, which all have a very similar time variation. Thus, the same type of time variation can be used for all these area sources. For example, traffic can be represented by one type of time variation, while house heating is represented by another.

You will find more information under the topic Time variation of emission

Time series, emission data (for point sources)

See also: Point sources | Time variation of emission | Types of time variation (area sources)

Time series of emission data (irregular variation) versus time variation (regular variation)

For both point and area sources it is possible to work with emissions that have a *regular variation with time*.

This type of variation is defined on a basis of month, day of week, and hour of day, and it is described in the topic Time variation of emission

On the other hand, if the pattern of emission is not regular, but you know the emission hour by hour, you should use a different feature: You can specify a complete **time series of emission data** for all hours. This feature applies only to point sources.

Time series of emission data - details

In this situation you must produce the necessary files in an external program, outside OML-Multi. The names of the relevant files must be indicated in the window ***File names assigned to the project*** in the field *Point sources, time series*.

When working with this type of sources, you are restricted to one substance only. If you have other sources with more than one substance, you will receive an error message and OML calculations will stop.

Other sources (point or area) are allowed, however, if they emit only one substance.

Construction of files

When using the time series feature, you must produce two or three files: *.tim, *.ems and possibly *.tbg.

!!! NB !!! All files must have a common (first) name. E.g., Test.tim, Test.ems and Test.tbg.

The ".tim" file contains data that are constant throughout the calculations.

The ".ems" file contains hourly data for emission, temperature and volume flux.

The ".tbg" file contains direction-dependent building data (if relevant).

The structure of the files appear from the sample files 'Timeseries sample.* '..

After a standard installation of OML-Multi these files will be located in the folder Samples (a subfolder under the default program folder).

The files are also listed below. The part of the text that is not required by OML-Multi is in italics.

The parameters are read using free format, implying that the decimal separator should be '.', and the separator between parameters should be blank or comma (','). The parameters must be indicated in the correct sequence, and no parameters can be omitted.

"*.tim" file:

```
THE FIRST 6 RECORDS ARE NOT READ.
Note "QID" takes up to 8 characters where blanks, '/' and ','  are not allowed.
X, Y and Z: Source position (m).  HS: Stack height (m).  DSI and DSO: Inner and outer
diameter of stack top (m).  HB: Effective general building height (m).
HBDD is indicator for direction dependent buildingdata in file *.tbg (1=data).
   QID      X       Y       Z      HS     DSI     DSO     HB  HBDD
abcdefg1    0.      0.     0.0   150.0    6.40    6.40    70.0 0       (Source no. 1)
b2        150.      0.     0.0   150.0    6.40    6.40     0.0 1       (no. 2)
c3          0.   -150.     0.0   150.0    6.40    6.40    70.0 0       (no. 3)
d4        150.   -150.     0.0   150.0    6.40    6.40    70.0 1       (no. 4)
```

The HBDD column specifies that there are direction-dependent building data for source no. 2 and 4.

"*.ems" file:

```
KELVIN  Temperature unit : "KELVIN " OR "CELSIUS".
******* In line 1 to 6 only the first 7 characters in the first line are read by OML-Multi.
        Hours from 1 to 24.
        Q: Emission (g/s), T: Temperature (K or C) and Vol: Volume flux (Nm3/s)
            ----source no. 1----  ----source no. 2----  ----source no. 3----   ... etc.
DATE  HOUR     Q(1) T(1)  VOL(1)     Q(2) T(2)  VOL(2)     Q(3) T(3)  VOL(3)
760101  1      0.00 273.    0.00   163.89 409.  103.17     0.00 273.    0.00   305.56 413.
760101  2      0.00 273.    0.00   166.67 410.  104.01     0.00 273.    0.00   213.89 411.
760101  3      0.00 273.    0.00   166.67 410.  104.01     0.00 273.    0.00   113.89 408.
760101  4      0.00 273.    0.00   166.67 410.  104.01     0.00 273.    0.00   113.89 408.
760101  5      0.00 273.    0.00   166.67 410.  104.01     0.00 273.    0.00   113.89 408.
760101  6      0.00 273.    0.00   166.67 410.  104.01     0.00 273.    0.00   130.56 408.
760101  7      0.00 273.    0.00   166.67 410.  104.01     0.00 273.    0.00   255.56 412.
760101  8      0.00 273.    0.00   166.67 410.  104.01     0.00 273.    0.00   305.56 413.
760101  9      0.00 273.    0.00   166.67 410.  104.01     0.00 273.    0.00   411.11 416.
760101 10      0.00 273.    0.00   166.67 410.  104.01     0.00 273.    0.00   452.78 418.
760101 11      0.00 273.    0.00   166.67 410.  104.01     0.00 273.    0.00   447.22 418.
760101 12      0.00 273.    0.00   169.44 410.  105.05     0.00 273.    0.00   447.22 418.
760101 13      0.00 273.    0.00   169.44 410.  105.05     0.00 273.    0.00   444.44 417.
760101 14      0.00 273.    0.00   169.44 410.  105.05     0.00 273.    0.00   441.67 417.
760101 15      0.00 273.    0.00   169.44 410.  105.05     0.00 273.    0.00   325.00 414.
760101 16      0.00 273.    0.00   166.67 410.  104.01     0.00 273.    0.00   430.56 417.
760101 17      0.00 273.    0.00   166.67 410.  104.01     0.00 273.    0.00   458.33 418.
760101 18      0.00 273.    0.00   180.56 412.  111.53     0.00 273.    0.00   458.33 418.
760101 19      0.00 273.    0.00   191.67 413.  116.96     0.00 273.    0.00   458.33 418.
760101 20      0.00 273.    0.00   188.89 413.  116.12     0.00 273.    0.00   458.33 418.
760101 21      0.00 273.    0.00   166.67 410.  104.01     0.00 273.    0.00   361.11 415.
760101 22      0.00 273.    0.00   169.44 410.  105.05     0.00 273.    0.00   308.33 413.
760101 23      0.00 273.    0.00   175.00 411.  108.81     0.00 273.    0.00   308.33 413.
760101 24      0.00 273.    0.00   186.11 412.  114.24     0.00 273.    0.00   308.33 413.
```

For the period shown (January 1, 1976), emission only takes place from source number 2 and 4. -The unit for time in the file is the same as in the meteorology file, e.g. LST (Local Standard Time).

"*.tbg" file:

```
Ver.5.00 From the first 3 lines only the text "Ver.5.00" is read and it should not be changed
The individual source data must end with the values for DD=360,in this sample " 360 0.0 0.0 "
 No.                                  No.:  Source number, only counting sources in timeseries
  2             DD      HB     Dist  DD:   Direction from source to building (deg.).
               100    75.0    110.0  HB:   Effective building height (m).
               110    75.0     66.0  Dist: Distance (m) from source to building.
               120    75.0     72.0
               130    75.0     84.0
               360     0.0      0.0
  4             DD      HB     Dist
                30    75.0    124.0
                40    75.0    118.0
                50    75.0    140.0
               360     0.0      0.0
```

The building data indicated here for sources 2 and 4 refer to the same building, which is situated between the sources. Relative to each of the sources its direction and distance are different.

The ".tbg" file has the same structure as ".kbg" files created through use of the menu system, when direction-dependent building data for point sources are entered.

Therefore, it is possible to use the menu to produce a 'dummy file' (e.g. dummy.kbg) with direction-dependent building data, and subsequently (using Explorer) rename it so it gets the correct extension for use as a tbg file (*.tbg).

Background levels

See also: Calculations | Special settings

If you wish to make calculations where you take account of background concentration levels, and possibly also of chemical reactions between NOx, NO2 and O3, you will have to provide information on background levels.

The menu **Sources | Background levels** opens the window ***Background concentrations (and global rad.)***.

Background concentrations are concentrations due to sources which are not explicitly included in the calculations, such as pollution brought to the calculation area by long range transport. The concentrations may be measured values, or they may be computed in another model which takes far-away sources into account.

The possibility to account for background levels can be useful, i.a. for mapping of concentrations in urban areas.
You must supply information on background levels, and the window ***Background concentrations (and global rad.)*** provides four options for you to do so:

1. **No data** (background concentrations are not used)
2. **NOx ,NO2, O3 and global radiation** ("Chemistry mode"; you supply an input file which includes values for global radiation)
3. **NOx, NO2, O3 (+simple model for global radiation)** ("Chemistry mode"; global radiation is computed based on data in the main meteorological input file)
4. **Subst. 1, subst. 2, subst. 3**

If you choose any other option than 1 ("No data"), you must supply a file with hourly values of concentrations. The concentrations (and possibly radiation data) must be available as a continuous time series without missing data. The time series must include the chosen calculation period.

Option 4 (*Subst.1, subst. 2, subst. 3*) is simple: With this choice, for each hour the substance concentration from the input file will be added to all receptor points.

"Chemistry mode"

Optionally, the OML-Multi model can apply a simple chemistry scheme for NOx, NO2 and O3. This option has been devised in order to be able to create urban background data for NOx, NO2 and ozone, which subsequently can be used as input to the so-called OSPM model (Operational Street Pollution model).

In "Chemistry mode", background concentrations and the concentrations from the "OML sources" are combined in the chemistry calculations. Thus, the concentrations are not simply added as in option 4.

"Chemistry mode" becomes active when the following conditions are fulfilled.

- Option 2) or 3) has been selected (and a file with background data is available).
- The substance names (for point sources and area sources) MUST be in the following sequence: NOx, NO2 and O3, even if there is no emission of NO2 or O3. When substance names are defined in the source menu, you *must* use the exact names NOX, NO2 and O3 (O3 means ozone).
- In the window Special settings for calculations and results, (that can be opened through **Calculations | Special settings**) you must specify that background data are used.

There is a sample file with background data NOxNO2O3 Test.dat included with OML-Multi.

During a standard installation of OML-Multi this file will be placed in the folder Samples (a subfolder under the default program folder).

As an illustration of the file format, the first 18 lines of the file are listed below:

```
Dummy data.
!! NB !! All units must be in µg/m3 and NOx concentration must be in NO2-units: µg NO2/m3 !!!
   i.e. for NOx and NO2: 1 ppb = 1.88 µg/m3, and for O3: 1 ppb = 2.00 µg/m3.
   e.g. NOx conc.: 10 µgNO/m3 + 10 µgNO2/m3 =(10*1.882/1.227 + 10) µgNO2/m3 =25.338 µgNO2/m3.
DATE   HR     NOx     NO2     O3      RAD
yymmdd hh     µg/m3   µg/m3   µg/m3   W/m2
760101  1     12.50   12.24   32.83   0.00
760101  2     10.17   8.89    40.67   0.17
760101  3     4.67    4.67    44.67   0.17
760101  4     6.00    5.74    44.17   0.00
760101  5     4.00    4.00    45.17   0.00
760101  6     2.33    2.33    45.33   0.00
760101  7     12.33   10.55   41.83   0.00
760101  8     11.83   10.30   41.83   0.33
760101  9     5.00    4.23    43.83   2.50
760101 10     7.50    7.24    41.67   18.17
760101 11     13.33   11.80   41.00   63.33
760101 12     8.33    8.08    39.67   90.83
```

The first 6 lines are not read by the program, and can freely be used for comments. Here, the lines have been used for a short description of the unit for concentration.

The subsequent lines contains 5 to 6 parameters in the sequence date, hour, NOx, NO2, O3, and possibly radiation.

Separator: space or comma. The format of date and hour must be the same as in the meteorological data file: yymmdd hr , where hr is in local standard time. hr runs from 1 to 24 and represents the hour before the indicated time.

!!! Note that concentration for NOx must be in units of NO2. !!!

Import Point sources

The menu **Sources|Import point sources** leads you to the window ***Import point sources.***
Data can be imported from a file produced by some external program, such as Microsoft Excel..
The file must be in CSV format (values separated by semicolon: ;).
The file must also fulfil certain other requirements.

OML-Multi is accompanied by a sample of a file with point source data for import in OML-Multi, namely the file Point Sample.csv.

The file has been generated from the Excel file Point Sample.xls.

After a standard installation of OML-Multi both files will be located in the folder Samples (a subfolder under the default program folder).

Import area sources

The menu **Sources|Import area sources** leads you to the window ***Import area sources.***
Data can be imported from a file produced by some external program, such as Microsoft Excel..
The file must be in CSV format (values separated by semicolon: ;).
The file must also fulfil certain other requirements.

OML-Multi is accompanied by a sample of a file with point source data for import in OML-Multi, namely the file Area Sample.csv.

The file has been generated from the Excel file Area Sample.xls.

After a standard installation of OML-Multi both files will be located in the folder Samples (a subfolder under the default program folder).

For area sources, it is not possible to import factors, which describe time variations. The user must manually enter data for the relevant types of time variations (maximum 5).

See also:
Area sources
Time variation of emission

Receptors menu

See also: Circular grid | Rectangular grid | Receptor grid, density | Co-ordinate system

The term *Receptor* is to be understood as a *Point where concentrations are computed*

The menu **Receptors** contains two options:

- Circular grid
- Rectangular grid

The OML model computes concentrations in a grid of receptors (calculation points). The user can choose to define his grid as concentric rings around a certain point (e.g., the most prominent source), or as a regular (rectangular) grid.

When a circular grid is used, concentrations will be computed in 36 directions.

The maximum number of receptors is 1681 (corresponding to a rectangular grid of 41 x 41 points).

The user is not confined to these two types of grids, but can actually use a grid with receptors placed anywhere. See Irregular receptor grid

Go to Contents

Circular grid

See also: Receptors menu | Circular grid | Rectangular grid | | Receptor grid, density | Co-ordinate system

The OML model can compute concentrations for a grid of receptors (receptor points). Most often, receptors are placed either as concentric rings around a certain point (e.g., the most prominent source), or as a regular (rectangular) grid.

The menu **Receptors|Circular grid** leads to the window ***Circular receptor grid***

Here, basic data concerning the receptor grid are entered: The centre of the circles, the distances to receptor rings, information about receptor heights and terrain.

Note that the rings of receptors should be defined with an appropriate density. If OML is used to determine stack heights, there should be no large gaps between those rings where the critical concentration values are found (see Receptor grid, density).

It is possible to adjust the height of the receptor and the terrain at each receptor. Use one of the 'Adjust' buttons on the right. The text 'Adjust' is written in italics when a value has been adjusted compared to the default value.

The window ***Circular receptor grid***:

- *Centre of receptor circles:* Typically, 0, 0 is chosen. See Co-ordinate system

- *Terrain heights, Identical heights...:* Typically 0 m is chosen. See Co-ordinate system and Terrain effect
- *Receptor heights above terrain, Identical heights...:*. Calculations will be conducted for receptors at this height. However, for individual receptors you can indicate another height using the 'Adjust' buttons.
  Typically, 1.5 m is chosen as receptor height (cf. the Danish Air emissions guideline section 3.1.3. Other common values are:
  2-story houses: 5 m
  5-story houses : 13 m
- *Roughness length z0:* This parameter describes the aerodynamic roughness of the terrain where computations are conducted. In Denmark, when determining stack heights, typical values are 0.1 m for rural areas and 0.3 m for urban areas.
- *Largest terrain inclination:* For flat terrain 0 degrees is used. This is common for Danish conditions. See also Terrain effect
- *Radius:* The distance to receptor rings can be defined by the user. A default grid with 15 rings at distances 50 - 2500 m is suggested, and can be used in many situations. When entering values, you don't have to care about the sequence of receptor rings. If you wish, you can sort the values using the **Sort** button. You can delete a ring by indicating 0 for its distance.
- *Individual receptor data | Terrain heights.* The 'Adjust' buttons allow you to indicate a terrain height at the location of the receptors. See also Terrain effect
- *Individual receptor data | Receptor heights* The 'Adjust' buttons allow you to indicate a height for any receptor. This option can be useful if you wish to let certain receptors reflect the situation in tall buildings. However, be careful about interpreting the results when you position a few receptors at a large height. See Interpretation of model output

Rectangular grid

See also: Receptors menu | Circular grid | Rectangular grid | Receptor grid, density | Co-ordinate system

The OML model can compute concentrations for a grid of receptors (receptor points). Most often, receptors are placed either as concentric rings around a certain point, or as a regular (rectangular) grid.

The menu **Receptors|Rectangular grid** leads to the window ***Rectangular receptor grid***

Here, basic data concerning the receptor grid are entered: The geometry of the grid, information about receptor heights and terrain.

Note that the grid of receptors should be defined with an appropriate density. If OML is used to determine stack heights, there should be no large gaps in the grid close to the location where the critical concentration values are found (see Receptor grid, density).

The window ***Rectangular receptor grid***:

- *Coordinates for grid centre:* Typically, 0, 0 is chosen. Note that this actually is the *centre* of the grid and not a corner of it. See Co-ordinate system
- *Total width of receptor grid:* Size of the rectangle enclosing the receptor grid.
- *Number of receptors:* The value for grid distance is updated when you leave the 'Number' field. The maximum number of receptors is 1681 (corresponding to 41 x 41 receptors).
- *Roughness length z0:* This parameter describes the aerodynamic roughness of the terrain where computations are conducted. In Denmark, when determining stack heights, typical values are 0.1 m for rural areas and 0.3 m for urban areas.
- *Largest terrain inclination:* For flat terrain 0 degrees is used. This is common for Danish conditions. See also Terrain effect
- The *Terrain button.* Allows you to indicate terrain heights at the locations of receptors. See also Terrain effect and Terrain heights window
- *The Receptor heights button* Allows you to indicate a common receptor height for all receptors, as well as individual heights for each receptor. The latter option can be useful if you wish to let certain receptors reflect the situation in tall buildings. However, be careful about interpreting the results when

you position a few receptors at a large height. See Interpretation of model output and Receptor heights window

Irregular receptor grid

See also: Circular grid | Rectangular grid | Receptor grid, density | Co-ordinate system

The OML model computes concentrations in a grid of receptors (calculation points).

Typically, the grid is arranged either as a number of concentric rings, or as a regular (rectangular) grid.

However, the user is not confined to these two types of grids, but can actually use a grid with receptors placed anywhere.

In this case, the user must construct a receptor file with his own tools - the menus cannot be used.

Note also that for an irregular grid you cannot present results graphically.

Format of receptor file

An example of a receptor file follows:

```
(First line)
(2.)
(3.)
(4.)
        X(m)       Y(m)      HT(m)      ZR(m)       Rec.nr.       z0= 0.300 Alfa=  0
   5     Ver.5.00                                                    ------       ---
         0.0        50.0      10.0       1.5           1
      -100.0       100.0       0.0       1.5           2
       -50.0         0.0       0.0       1.5           3
       150.0       -50.0      20.0       1.5           4
       300.0       300.0       0.0       1.5           5
```

This sample file consists of 11 lines. The first 4 lines are not read by OML-Multi and can be used for the users own comments.

Line 5 contains the values for *z0* (aerodynamic roughness length) and *Alfa* (general terrain inclination). These numbers should be positioned in, respectively, columns 65-70 and 77-79.

In line 6 the text "Ver.5.00" must be written in columns 10-17. (The number "5" at the beginning of the line indicates the number of receptors, but it may be omitted).

Each of the subsequent lines carry information about a receptor: x,y-coordinate (m), terrain height (m) and receptor height above the ground (m). The 5th value on the line is not required - here, it indicates the receptor ID used internally in OML-Multi. There must be at least one blank between each value on the line.

! NB The decimal separator used here must be "." (not comma). !!!

See also: Manually created files

Receptor grid, density

See also: Receptors menu | Circular grid | Rectangular grid | Receptor grid, density | Co-ordinate system

The term Receptor is to be understood as a *Point where concentrations are computed.*

The OML model computes concentrations in a grid of receptors (calculation points). The user can choose to define his grid as concentric rings around a certain point (e.g., the most prominent source), or as a regular (rectangular) grid.

When a circular grid is used, concentrations will be computed in 36 directions.

The maximum number of receptors is 1681 (corresponding to a rectangular grid of 41 x 41 points).

Note that the grid of receptors should be defined with an appropriate density. If OML is used to determine stack heights, there should be no large gaps in the grid close to the location where the critical concentration values are found.

If the critical concentration value is found among the receptors closest or farthest away from a certain source, you should consider to adjust the grid and repeat the calculations.

However, in cases where building effects are present, it is not always possible to avoid that the maximum occurs at the receptors closest to the source. Close to buildings, concentrations computed by the OML model are constant (along a certain direction). When you have a general building effect, concentrations will be constant within a circle, having a radius of two times the building height. See the note "Handling the influence of buildings in the OML model" for further details.

See also: Building effect

Co-ordinate system

See also: Receptors menu | Circular grid | Rectangular grid | Receptor grid, density | Co-ordinate system

OML-Multi uses an x,y-coordinate system, which is common to sources and receptors. The x axis points towards the East, the y axis towards the North, and the unit is meter.

The origin of the coordinate system can be selected freely by the user. It is often convenient to locate the origin at the largest source, which then has coordinates (0,0).

There is also a z coordinate to the coordinate system. One option is to locate the origin at sea level. However, often it is more convenient to displace the origin vertically, so it coincides with the level of the base of one of the sources.

As a consequence, terrains heights can be negative.

Note further:

The source height (as specified in the **Sources** menu) is defined as the height above terrain.

Also receptor heights are defined as height above terrain.

When you enter direction-dependent building data, you specify the data relative to a polar coordinate system with origin at the source in question. For details, see Direction-dependent building effect: Entering data

Receptor heights window (for rectangular grid)

See also: Receptors menu | Circular grid | Rectangular grid | Receptor grid, density | Co-ordinate system

The menu *Receptors*|*Rectangular grid*|*Rec. heights* leads to the **Receptor heights** window.

Here, the height of receptors are defined for a rectangular grid.

Typically, 1.5 m is chosen as general receptor height - in accordance with the Danish air emissions guidelines section 3.1.3.

Other commonly used values are:

2-story buildings : 5 m
5-story buildings : 13 m

You can also indicate a height for any individual receptor. This option can be useful if you wish to let certain receptors reflect the situation in tall buildings. However, be careful about interpreting the results when you position a few receptors at a large height. See Interpretation of model output

The practical use of the **Receptor heights** window is explained here:

- *The map of receptors:* As you move the mouse over the map, the coordinates of receptors are shown. A click on a receptor allows you to change the receptor height.
- *The field "Height"* shows the height of the current receptor and allows you to change it.
- *The "Paint" radio buttons* determine whether the colours on the map show changes of receptor heights, or whether the colour scale should indicate the heights of receptors.
- *The button "Equal heights"*: Assign the same receptor height to all receptors.

Terrain effect

See also: Receptors menu | Terrain heights window | Co-ordinate system

Generally about terrain and OML

The OML model uses relatively simple procedures for terrain correction. It is not suitable for precise calculations in mountainous terrain.

The effect from terrain on concentrations depends partly by terrain height, partly by terrain inclination.

OML-Multi only accounts for terrain effects when the largest terrain inclination is different from zero.

Internally in OML, the procedure for terrain correction works by reducing the plume height. The largest possible reduction of plume height at a certain receptor point is equal to the difference between the level of the terrain height and the level of the stack base.

For relatively flat terrain (e.g. Danish conditions), at large distances from the source (more than 20 stack heights), the structure of the terrain is not very important in respect to the maximum concentrations. Therefore often a crude terrain description is adequate for OML computations.

Terrain height

Typically, one will try to select a co-ordinate system in such a way that most (or all) receptors have a terrain height of zero. Exceptions to this rule can be entered using the 'Adjust' buttons.

Terrain inclination

OML-Multi can handle only one terrain inclination angle in one model run. The value of the inclination does not have any effect on concentrations at receptors located at terrain heights lower than the terrain height at the source. At calculation sites with many different inclinations, the correct - but rather time consuming - way to perform calculations is the following: the calculation site (and receptors) is divided into areas with the same inclination, and for every area a set of calculations with the correct inclination is performed.

Simplified approach:

A simpler, but somewhat conservative approach - that can be applied when the receptor heights are much smaller that the stack height - is to conduct *one set of calculations with the largest terrain inclination in the area*. The effect of terrain on the maximum 99 percent fractile is often only 5-10%, and even if the concentration is overestimated for areas with a smaller inclination than the maximum, this overestimation will be relatively insignificant.

Hint: The magnitude of the terrain correction can be assessed by performing a set of calculations with inclination zero. If the correction is less than 5%, the result must be considered reasonably stable.

Multi-step approach

A more detailed approach can be relevant. When the parameter of interest is only the maximum concentration (or parameters closely related to maximum concentration, such as the 99 percentile), it is normally sufficient to perform one or two complete computations to determine the correct value. First, a set of calculations is performed, where the largest inclination in the area of interest is used. If the calculations show that maximum is located in an area with terrain heights lower than or equal to terrain heights at the stack base (area A), or it is located in the area with the largest inclination (area B), then the maximum has been correctly determined.

On the other hand, if the maximum is in a third area (C), one more set of calculations should be produced. This time, use the inclination for area C. In the new set of calculations the maximum will most often remain the same place as before and indicate the correct maximum. If maximum is located in a different location, it is necessary to compare the results from area C with the results from area A and B. The larger value from the comparison will be correct.

In some very few cases the maximum can move once more, and a new calculation with a new inclination should be produced.

Terrain heights window

See also: Terrain effect | Receptors menu | Circular grid | Rectangular grid | Receptor grid, density | Co-ordinate system

The principles underlying treatment of terrain in the OML model are explained in the topic Terrain effect.

The menu *Receptors*|*Rectangular grid*|*Terrain* leads to the **Terrain heights** window.

Here, terrain heights at receptor points are defined for a rectangular grid.

The practical use of the **Terrain heights** window is explained here:

- *The map of receptors:* As you move the mouse over the map, the coordinates of receptors are shown. A click on a receptor allows you to change the terrain height at this receptor..
- *The field "Height"* shows the terrain height at the current receptor and allows you to change it.
- *The "Paint" radio buttons* determine whether the colours on the map show changes of terrain heights, or whether the colour scale should indicate the terrain heights at receptors.
- *The button "Equal heights"*: Assign the same terrain height to all receptors. Later, you can change some points to other values.

Calculations

Calculations can be performed for an entire year or for a selected period.

Sometimes, it is a good idea to change between calculations for an entire year and for a single month - see Getting started with OML - the principles; Advice about calculation strategy

Elements of the Calculation window

Comments on the calculation

You may assign comments to the set of calculations. The comments will appear on the printed output (if you later - in the **Result** window - check the appropriate box).

Period of time

Remove the checkmark at "Complete year" if you wish to make calculations for a shorter period.

Hours run from 1 to 24 and are in Local Standard Time (see also. New format for the meteorological file)

Special settings

The button gives access to a wide range of settings.

Under and after the calculations

The calculations are started by pressing "Execute".
It is not necessary to use the button "Save". That button is useful if you have changed settings and wish to leave the ***Calculations and settings*** window without performing any calculations.

The calculations take place in a DOS window, and they can be stopped by pressing Ctrl-Break (or Ctrl-C).

Note: Under Windows 2000 calculations will stop if you click in the window!

You can continue by right-clicking or pressing any key.

It the calculations result in an error message, then click OK, and look for further information on the screen or in the file with results.

See also:

Results

Interpretation of model output

Special settings

See also: Calculations

Select the **Calculations** menu and then click the button **Special settings** in order to go the window ***Special settings for calculations and results***

The settings concern the following options

- *Types of sources to be used.* The checkmarks here determines the types of sources to be included in the calculations. See more...
- *Format of numbers in output* Exponential is a format such as 3.220E+0002 for 322. Even if you have asked for a fixed format you may obtain results in exponential format. That happens if the calculation results are very small or very large.
- *Language in output*. This option concerns output, while the language for the menus is determined from the menu **Files**, see Language)
- *Resolution of wind direction* Concerns the meteorological data. For Danish default data it should be 10 degrees, but if you use local data, the setting may have to be changed.. See more...
- *Use background data for the calculations* See Background levels
- *Grouping of sources in output* Allows you to analyse the effect of certain sources or groups of sources without repeating the calculations..
- *Summer time* (Daylight saving time) Is only relevant if you use time variation of emission
- *Meteorological year in calculations:* Is 1976 for Danish default data. If you use local data, the setting should be changed.
- *Dump time series of concentrations in selected receptors* For special analyses. See more...

If you wish to define which units for emission to use in future projects, you must go to the menu Settings for point sources.

Source types

The Special settings window allow you to define, which types of sources the calculations should include.

- Point sources
- Point sources, time series emission
- Area sources

Thus, it is possible in a project to define sources, but omit them from a set of calculations.

For sources of the type *Point sources, time series emission*, you must produce input files in an external program, outside OML-Multi.

See Time series, emission data

Timeseries in selected receptors

See also: Calculations | Special settings

It is possible for selected receptors to dump concentrations hour by hour. The concentration values are written to a file named by the user. The output is a (long) file with hourly averaged concentrations value (microgram/m3).

The user must identify the receptors for which he wants results dumped. The order of the receptors is irrelevant. No more than 100 receptors may be included in the list.

For a **rectangular grid** the receptor numbers can easily be identified in a graphical manner, using either

1. the menu Receptors / Rectangular grid / Terrain

or

2. the menu Results / Graphic and then selecting a table

The latter option requires that you have performed a set of calculations. Hold the mouse over the map, and you can read the coordinates and receptor number of the corresponding receptor. The numbering begins in the upper left-hand corner (Northwest) of the receptor grid, and it continues in the same manner as you would read the letters in a book.

For a **circular grid** only the second option is available. Numbering begins in the inner circle in the direction 0 degrees (North), and continues outwards. Next, numbering continues in the inner circle at direction 10 degrees.

A sample of the contents of a dumped file is shown below. The first three lines contain a short explanation. Next follows a line with data for each hour.

The first three parameters 'Date', hr LST and 'hr Sum.' refer to date, Local Standard Time (corresponding to the meteorological file) and summer time (Daylight Saving Time) as defined by the user in the 'Special settings' menu.

Next follow three values for the first receptor, then three values for the second receptor etc.

The meaning of these three values depend on the setup of the calculations, as explained next.

If the calculations have been conducted for **three substances**, the three numbers refer to these substances.

If the calculations have been conducted for **two substances**, three values are listed, while the third value is zero.

Dumped file involving three substances. Period with summertime 'active'. The decimal separator is ','.

Rec.:			371			200		
Date	hr LST	hr Sum.	SO2	NOx	Dust	SO2	NOx	Dust
760504	1	2	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
760504	2	3	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
760504	3	4	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
760504	4	5	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
760504	5	6	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
760504	6	7	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
760504	7	8	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
760504	8	9	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
760504	9	10	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
760504	10	11	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
760504	11	12	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
760504	12	13	0,00E+00	0,00E+00	0,00E+00	4,44E+00	2,22E+00	8,89E-01
760504	13	14	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
760504	14	15	0,00E+00	0,00E+00	0,00E+00	1,06E+00	5,28E-01	2,11E-01
760504	15	16	0,00E+00	0,00E+00	0,00E+00	4,70E+01	2,35E+01	9,39E+00
760504	16	17	0,00E+00	0,00E+00	0,00E+00	4,89E+02	2,44E+02	9,77E+01
760504	17	18	7,77E+00	3,89E+00	1,55E+00	3,31E+02	1,66E+02	6,63E+01
760504	18	19	2,99E+01	1,50E+01	5,98E+00	1,90E+02	9,49E+01	3,79E+01
760504	19	20	0,00E+00	0,00E+00	0,00E+00	7,24E+02	3,62E+02	1,45E+02
760504	20	21	7,98E+00	3,99E+00	1,60E+00	3,62E+02	1,81E+02	7,24E+01
760504	21	22	0,00E+00	0,00E+00	0,00E+00	6,74E+02	3,37E+02	1,35E+02
760504	22	23	3,50E+00	1,75E+00	7,01E-01	4,75E+02	2,38E+02	9,50E+01
760504	23	24	6,59E+02	3,30E+02	1,32E+02	4,31E-01	2,15E-01	8,62E-02
760504	24	1	1,14E+00	5,71E-01	2,28E-01	5,94E+02	2,97E+02	1,19E+02

If the set of calculations has been conducted for **one substance only** (with or without grouping of sources), the three values have the following meaning:

- The first concentration is the sum of contributions from all sources.
- The next two concentrations are for groups of sources, as defined by the user. See 'Special settings...'.

In the example shown below source number 2 and 3 are grouped.

If no grouping is defined, the two last values will be zero.

Dumped file with one substance and grouping of sources. Summer time is not 'active'. Decimal separator is '.'.

```
Rec.:                      55                              80
 Date   hr hr    All        2-       0-       All        2-       0-
     LST Sum.  sources       3        0       sources      3        0
760101   1   1   0.00E+00 0.00E+00 0.00E+00   1.62E+01 6.08E+00 0.00E+00
760101   2   2   0.00E+00 0.00E+00 0.00E+00   6.13E+00 2.30E+00 0.00E+00
760101   3   3   1.97E+01 7.38E+00 0.00E+00   2.31E+01 8.68E+00 0.00E+00
760101   4   4   1.65E+01 6.18E+00 0.00E+00   3.82E+01 1.43E+01 0.00E+00
760101   5   5   7.27E+00 2.73E+00 0.00E+00   3.37E+01 1.26E+01 0.00E+00
760101   6   6   2.53E+01 9.50E+00 0.00E+00   1.58E+01 5.93E+00 0.00E+00
760101   7   7   2.61E+02 9.79E+01 0.00E+00   2.52E-01 9.44E-02 0.00E+00
760101   8   8   0.00E+00 0.00E+00 0.00E+00   3.62E-01 1.36E-01 0.00E+00
760101   9   9   0.00E+00 0.00E+00 0.00E+00   9.15E+00 3.43E+00 0.00E+00
760101  10  10   0.00E+00 0.00E+00 0.00E+00   1.42E+01 5.31E+00 0.00E+00
760101  11  11   0.00E+00 0.00E+00 0.00E+00   8.81E-01 3.30E-01 0.00E+00
760101  12  12   0.00E+00 0.00E+00 0.00E+00   3.13E+00 1.18E+00 0.00E+00
760101  13  13   0.00E+00 0.00E+00 0.00E+00   5.10E-01 1.91E-01 0.00E+00
760101  14  14   6.19E-01 2.32E-01 0.00E+00   2.00E+01 7.52E+00 0.00E+00
760101  15  15   0.00E+00 0.00E+00 0.00E+00   5.59E+00 2.10E+00 0.00E+00
760101  16  16   0.00E+00 0.00E+00 0.00E+00   0.00E+00 0.00E+00 0.00E+00
760101  17  17   0.00E+00 0.00E+00 0.00E+00   5.91E-01 2.21E-01 0.00E+00
760101  18  18   0.00E+00 0.00E+00 0.00E+00   1.05E+01 3.94E+00 0.00E+00
760101  19  19   0.00E+00 0.00E+00 0.00E+00   3.54E+00 1.33E+00 0.00E+00
760101  20  20   0.00E+00 0.00E+00 0.00E+00   3.46E+00 1.30E+00 0.00E+00
760101  21  21   0.00E+00 0.00E+00 0.00E+00   0.00E+00 0.00E+00 0.00E+00
760101  22  22   0.00E+00 0.00E+00 0.00E+00   9.11E-01 3.41E-01 0.00E+00
760101  23  23   0.00E+00 0.00E+00 0.00E+00   2.97E+01 1.11E+01 0.00E+00
760101  24  24   0.00E+00 0.00E+00 0.00E+00   8.08E-01 3.03E-01 0.00E+00
```

Resolution of wind direction data

See also: Calculations | Special settings

Wind direction is sometimes indicated with a resolution of 1 degree, but very often with a resolution of 10 degrees.

Danish standard data (Kastrup 1976) and many other Danish data sets use a resolution of 10 degrees.

In the Special settings menu you must specify the resolution of the data set that you use.

The OML model performs a check, and issues a message if the specification is incorrect.

The wind direction for every hour is written in the meteorological data file (position 19-21).

See also: New format for the meteorological file

New format for the meteorological file

OML-Multi 5.0 uses another format for the meteorological data file than previous OML versions (before 2002).
If a user applies a meteorological file in the old format he is warned by an error message.

In previous meteorological files, times were indicated in GMT, and hours were numbered from 0 to 23.
In the new format LST (Local Standard Time) is used, and hours are numbered from 1 to 24.

For Danish data there will be no change in results; when the time is 0 GMT it will be 1 LST according to Danish normal time.

Normally, there is no need for conversion of data, because the data shipped with OML-Multi are in the proper format.

Conversion of files in the pre-2002 format

If you have a meteorological file in the old format and wish to convert it to the new format, you must edit it in the following way:

1. In line 7, column 7-9 of the meteorological file, you must enter the text "LST" (don't enter the quotes).
2. The indication of time should be changed, so hours are numbered from 1 to 24. For Denmark

(Western Europe) this is easy, because when the time is 0 GMT it will be 1 according to Danish Local Standard Time. Thus, the changes can be implemented by editing only the value for HR (hour) so that 0 is replaced by 1 etc.
In Eastern Europe, where the time difference to Greenwich is 2 hours, one must edit both the date and the hour.
In practice, this can be most easily achieved by using a text editor that allows block copying, so the entire block of date and time is copied from a file with correct format.

See also:
Meteorological data

Results

See also Limit values: | Interpretation of model output

The window ***Results*** allows you to browse through results and to print them.

Further, you can display simple graphs of results, and you can export results for use in third-party graphics software.

Normal choices

Comments from calculations... refer to basic information about meteorology data, coordinate system and receptor net.

User comments can be defined by the user in the ***Calculations*** menu

Project name at first page: If checked, the project name appears in the heading of page 1.

Terrain heights when not identical: If checked, the terrain height for all receptors will be listed - unless they are all identical.

Receptor heights when not identical: If checked, the receptor height for all receptors will be listed - unless they are all identical.

Receptor data when not circular or rectangular grid: Only relevant if the receptor grid is neither circular nor rectangular. If checked, receptor data will be listed.

Maximum of monthly 99-percentiles: Danish limit values refer to this parameter. It is compared to the so-called *C-value.* See What is the maximum 99-percentile?

Special choices

The special choices allow you to produce tables of statistical parameters that are relevant in the context of EU air quality directives.

As an example, the limit value for NO2 is given as a value that may be exceeded 18 times a year. Thus, in this case the *19th highest* hourly concentration is of relevance for comparison with the limit value.

One detail: The parameters are most meaningful when calculations are performed for an entire year. If you perform calculations for a shorter period, please note that - e.g. - the expression '19th highest hourly value' refers to the 19th highest value *during the period you have indicated.*

See also Limit values

The buttons

- The button **Show**. Results are shown.
- The button **Export x,y,conc**. Normally, printed tables are produced. However, this button allows the user to select a table and export data to a file. More...
- The button **Graphic** Select a table and display it as a simple graph. More
- The button "**Recreate standard**" Resets checkings in the menu to their default.
- The button "**Save as default**": Allows you to save your choice of checkings in the menu. The program will use the saved chekings until you save checkings once more, or until you choose "Recreate standard"

See also: Interpretation of model output

What is the maximum 99-percentile?

In Denmark, the OML-model is very frequently used in the context of stack height determination

according to the Danish air emissions guidelines.

At the end of OML calculations, the model can summarise concentration values for all receptors and all hours in the year in the form of one, single number: the maximum of monthly 99-percentiles This number is compared to the so-called *C-value* for the substance in question.

The maximum of monthly 99-percentiles represents one of the largest concentration for any hour in the year. The definition is elaborated in the topic Maximum of monthly 99-percentiles: Definition

For more information about Danish regulations and C-values, see the topic Danish air emissions guidelines.

Note that the Danish term *B-værdi* has been translated into the English term *C-value*

Maximum of monthly 99-percentiles: Definition

The maximum of monthly 99-percentiles based on one year of meteorology may also be referred to as a ***99 percent fractile.***

This parameter is central in respect to Danish regulations (the Danish air emissions guidelines), as it is compared to the so-called *C-value*. It is determined according to the following procedure:

Consider a certain receptor. Compute all hourly concentrations during one month (typically 720 numbers). Find the number, which is exceeded in one percent of the time (i.e., 7 hours). This is the monthly 99-percentile for the receptor in question (for the month considered).

Now, repeat the above steps ***for all receptor points*** and ***for all 12 months of the year***.

Select the largest of all these 99-percentiles. This is the ***maximum of monthly 99-percentiles***, based on one year of meteorology.

Graphical output

See also: Line draw file | Export results | Printing graphics

In the **Results menu**, the button **Graphic** allows you to display the geographical pattern of results.
You are asked to select a table for display.
In addition to tables of concentrations, you have the option of displaying terrain heights or receptor heights.
You will receive a warning if the numbers in the table have less than 3 significant digits.

Graphical presentation

Results are presented graphically in the form of a crude map of concentrations. As you move the mouse over the map, the upper line of the display shows the current coordinates and the concentration.

The maximum value on the map is indicated by a cross.

The precise location of the receptors on the map is as follows:

- For a **circular net** receptor points are centered in the 'pie slices'. However, for the outermost ring, receptors are located on the very edge of the 'slice' (implying that this 'pie slice' has only 'half length' compared to others).
- For a **rectangular grid** each receptor is represented by a square, where the receptor is placed in the centre. ***Thus, the map covers a larger area than the receptor grid itself*****:** For instance, if the receptor grid is 900 x 900 m with squares of 100 x 100 m, the outermost squares will extend 50 meters beyond the grid, so the area displayed is 1000 x 1000 m.

The buttons:

- *Scale.* The **Scale** button provides information on the scale and lets the user adjust the scale.
- *Liniefil (Line draw file)* The user can use a file (defined by himself) to draw lines on the map. Details about Line draw file. (including example)..
- *Draw lines* If a "Line draw file" has been associated, this box determines whether the lines can be seen on the map.

Printing graphics

See also: Graphical output | Line draw file | Export results

In order to export graphics from OML-Multi to other applications, it is necessary to make a screen dump.

Let us assume that you wish to include graphics with OML results in a Word document.

The recipe is as follows:

When the graph is on the screen, you can adjust the size of it by dragging the border of the window.

Pay attention to where you place the mouse in the end, because this determines the numbers shown on top of the screen.

Then press **Alt** + **PrintScreen.**

You don't get any receipt to tell you that something has happened, but actually the clipboard now contains a copy of the active window.

Now change program to Word to paste the picture into your document.

If you wish to add a scale to your Word document, then return to OML-Multi and press the button **Scale**. Again use the procedure with **Alt** + **PrintScreen** in order to transfer the picture to Word.

If you wish a higher quality of your graphics, you will have to export your results to a file and use a third-party application that is capable of creating contour plots (e.g. Surfer from Golden Software, www.goldensoftware.com).

Warning about integers (graphical presentation)

If you request a simple graphical presentation, you may encounter the following warning:
"The concentrations in the table is in whole numbers (integers), but this is probably not optimal"

The warning is issued when none of the numbers in the table of concentrations has 3 significant digits. You may choose to ignore the warning, or you can repeat the calculations with new settings (see Special settings). The setting that should be changed concerns the format of numbers in output, and you should choose *Exponential.*

Line draw file

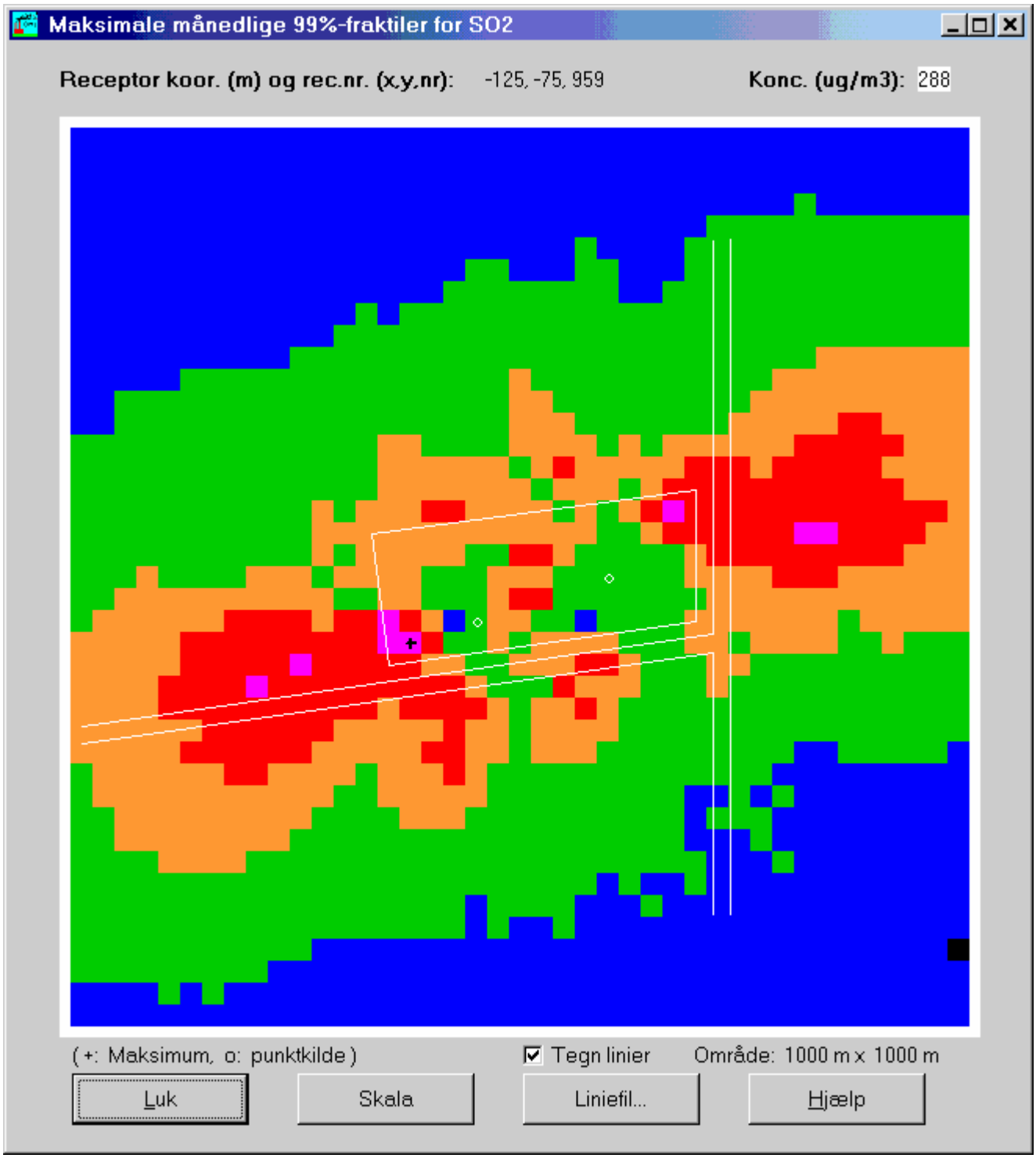
See also: Graphical output | How to use the Example-2 files

A *Line draw file* (Liniefil) can be used to draw lines on a map of concentration levels, as produced by OML..

The user must construct the file with an external program, outside OML-Multi. It can be produced with an editor or exported from some other software.

The lines can be used to show the borders of a property, roads or coast lines etc.

A sample graphic is shown here. Below the figure, the file format is explained.



Format of a Line draw file

A Line draw file must have the structure illustrated below. The decimal separator must be '.' (point).

The sample file can be found as the file LineAndBox.dat in the Samples folder (a subfolder under the default program folder).

```
5 Company property line (Box)       (1.linie)
-150 -100
-170   50
 200  100
 200  -50
```

```
-150 -100
3 Roadside NW
-500 -170
 220  -65
 220  385
3 Roadside SW
-500 -190
 220  -85
 220 -385
2 Roadside East
 240  385
 240 -385
```

There are several blocks of lines in the file.

In the first line, OML reads the number (here: '5'), while the remaining text is ignored.

The number indicates how many lines the following block contains.

The lines in this block contain pairs of x,y coordinates. A line is drawn between these points. The 5 pairs of numbers define a polygon (the border of the company property). The first and last line in the block are identical, so the polygon is closed.

The second block begins in line 7.

There are no restrictions on the number of lines in a block, and no restrictions on the number of blocks.

See also: Graphical output

Export results

In the **Results** menu, the button **Export x,y, conc** can be used to export the computed concentrations to a file.

Furthermore, terrain heights, receptor height, and coordinates of sources can be exported.

The files thus produced can be used by a GIS application or some other third-party software.

If you wish to export data from more than one table, you will have to repeat the export process.

The file produced has a format with 3 fixed columns (below a one-line heading). The user can choose how the columns should be separated (using spaces or a tabulator), and he can choose the decimal symbol.

The first column indicates an x coordinate (East), the second a y coordinate (North), and the third the concentration (or height).

Sample of an exported file:

```
       x         y          c/z
       0       500  5.100E+0001
       0      1000  3.220E+0002
       0      1500  3.810E+0002
       0      2000  3.200E+0002
       0      2500  2.640E+0002
```

See also Time series in selected receptors (about the possibiity to dump data hour by hour)

What is OML?

OML means *Operational Meteorological Air Quality Models* and is an abbreviation of the Danish title *'Operationelle Meteorologiske Luftkvalitets-modeller'*.

OML-Multi is an atmospheric dispersion model, used to assess air pollution from sources such as stacks and area sources. It can be used at distances up to around 20 km from the sources. OML-Multi is a modern Gaussian plume model, based on boundary layer scaling instead of relying on Pasquill stability classification such as older models do. The model has been developed by the National Environmental Research Institute (NERI) in Denmark.

The OML model is frequently applied for regulatory purposes. Thus, it is the recommended model to be used for environmental impact assessments when new industrial sources are planned in Denmark. It is used to demonstrate that planned facilities comply with the Danish Guidelines for Air Emission Regulation.

Besides such studies on compliance, the model can be used for environmental assessments where air pollution has to be mapped for an entire urban area.

The present help text concerns the version of OML called OML-Multi.

Also another version of OML exists, namely *OML-Point*. OML-Point has limited functionality compared to OML-Multi, and it does not exist in an English Windows version..

See also:

OML: Features and limitations

Previous OML versions

Getting started with OML - the principles

Supplementary information

Version number

The official version number is displayed in the box that appears when you go through the menu **Help > About**.

Minor changes may be introduced that are not reflected by this official version number; however, they are revealed by the dates shown in this box.

OML-Multi consists of two applications

- The menu application that provides the user interface
- The calculation core

The calculation core determines the results of the calculations. The date for the latest revision of the calculation core appears in the written output from OML-Multi. In the page header you will find a text that may read "OML-Multi PC-version 20021010/5.01 ".

See also: Version history

OML: Features and limitations

Time resolution

The OML model is a time series model. It computes an hourly time series of concentrations at user-specified receptor points, from which statistics are extracted and presented to the user. A basic assumption underlying the model is that the plume disperses according to a Gaussian distribution.

The model cannot be applied directly for problems where the relevant averaging time is shorter than one hour (however, in relation to odour, a workaround is sometimes applied - see the topic Odour).

The model assumes that emissions do not vary rapidly with time; thus, the model is not suitable for handling accidental releases.

Meteorological input

When the model is used for regulatory purposes (stack height determination) in Denmark, normally

a standard set of meteorological data is used. This data set is bundled with the model.

Users outside of Denmark - and some Danish users - will need a pre-processed meteorological data set representing local conditions. See Meteorological data.

Receptors (grid of calculation points)

The maximum number of receptors is 1681 (corresponding to a grid with 41 x 41 points).

Number of sources

The OML model permits a maximum of 3000 sources (the total of point and area sources).

Heavy gasses and very wet plumes

Note that the OML model should not be applied for or gases that are substantially heavier than the surrounding air. Details about heavy gasses...

Also, the OML model cannot be expected to yield reliable results if gases with an extremely high humidity content are considered.. Details about very wet plumes...

See also:

What is OML?
Supplementary information

Heavy gasses

The OML model cannot be used for gases that are substantially heavier than the surrounding air, because the model cannot handle a negative 'plume rise'.

When computing plume rise the quantity of interest is the density of the *mixture of gases* - not the molecular weight of the individual components.

Thus, the model should not be used when the substance emitted is very much colder than the surrounding air.

See also: OML: Features and limitations

Very wet plumes

The OML model cannot be expected to yield reliable results if gases with an extremely high humidity content are considered.

Certain production facilities may produce a plume that has a large content of liquid water, and the result may be that the plume does not rise, but sinks, and that droplets fall from the plume.

Problems with such very wet plumes are hard to quantify.

Some relevant information can be found on the (Danish) web page
http://www.dmu.dk/AtmosphericEnvironment/vaadroeg.htm

See also: OML: Features and limitations

Previous OML versions

This version

This version is OML-Multi version 5.03.

There have been versions of OML-Multi prior to version 5, but they are hardly relevant for international users.

If you seek information about the relation to version 4.2 and other previous versions, you will have to consult the Danish version of the Help text.

See also

Version history (explaining the history of minor revisions within version 5)

Version number.

Interpretation of model output

When interpreting model output, pay attention to the following issues:

Roughness length

Pay attention to the value of the roughness length, z0,. The value used is indicated in the model output under the heading *Receptor data.*

Receptor grid

Note that the grid of receptors should be defined with an appropriate density. If OML is used to determine stack heights, there should be no large gaps in the grid close to the location where the critical concentration values are found.

If the critical concentration value is found among the receptors closest or farthest away from a certain source, you should consider to adjust the grid and repeat the calculations.

See Receptor grid, density.

Direction-dependent information

The geographical distribution of computed concentration should not be taken too literally, because the results are based on meteorology from only one year.

In particular, be careful about conclusions if the calculations involve *direction-dependent building effects* or *receptors placed at a large height in a limited number of directions* (tall buildings). The pattern of computed concentrations will be the result of an interaction between the wind directions appearing in the met. data set and the input of the user. When user input is direction-dependent, the end result will be particularly sensitive to the frequency of occurrence of certain wind directions.

The concentrations computed by the model are a reasonable first guess describing the situation, but a more complete picture of the situation can be obtained by pretending that the tall building covers a wider angle than it actually does.

Danish air emissions guidelines

The current version of the Danish air emissions guidelines has been translated to English and is called:

"Guidelines for Air Emission Regulation", Vejledning nr. 1, Miljøstyrelsen 2002.

The Danish version is referred to as **"Luftvejledningen"**, Vejledning nr. 2, Miljøstyrelsen 2001

Both the Danish and the English versions are available on the Internet as on the OML CD.

On the Internet:

In Danish: http://www.mst.dk/udgiv/publikationer/2001/87-7944-625-6/pdf/87-7944-625-6.PDF
In English http://www.mst.dk/udgiv/Publications/2002/87-7972-035-8/pdf/87-7972-036-6.PDF

On the CD, look in the folder **Supplement**

A guideline related to the Danish air emissions guidelines is the list of limit values for various substances, referred to as:

"B-værdivejledningen. Oversigt over B-værdier".

Vejledning fra Miljøstyrelsen Nr.2 2002.

Available through the Internet as
http://www.mst.dk/udgiv/publikationer/2002/87-7972-099-4/pdf/87-7972-099-4.pdf

On the CD, look in the folder **Supplement**

Limit values

See also: Note on EU directives | Results

When determining stack heights in Denmark, the result of calculations is compared to the so-called C-

value (in Danish: 'B-værdi') which is defined in guidelines from the Danish EPA (Miljøstyrelsens Luftvejledning and the B-værdivejledning.)

In many other contexts, however, the EU air quality limit values are the relevant base for comparisons.

See e.g. the web sites:

http://www2.dmu.dk/1_Viden/2_miljoe-tilstand/3_luft/4_maalinger/5_niveauer/graensevaerdier_en.asp

http://europa.eu.int/comm/environment/air/legis.htm

Note on EU directives on air quality (in Danish)

See also Limit values: | Results

On the CD you will find a note in Danish called

Notat om EU direktiver om luftkvalitet which is authored by Finn Palmgren Jensen, NERI (July 2002).

The note (EU_direktiver.pdf) is located in the folder **Supplement**.

Supplementary information

World Wide Web

You can find further information on the model through the Internet, *http://www.oml-international.dmu.dk*

Look at this site for updates to the program and to this help text.

Computer-related hints

Go to Contents

Things you should know

Tab key

The easiest way to move from one field to the next is to use the Tab key or the Enter key (Shift+Tabulator brings you one step backwards). The arrow keys can only be of use in certain contexts.

Comma

The decimal separator can be entered as a comma (,) or as a point (.). No matter how it is entered, it will appear on the screen as a point.

Windows XP

If you use Windows XP, you must once and for all adjust a certain setting concerning 'compatibility mode'. More...

See also Computer-related hints

Windows XP hint

If you use Windows XP, you must once and for all adjust a certain setting (the relevant information is also provided during the installation of OML-Multi).

Follow the instructions below.

- Right-click the OML icon on your desktop.
- Choose Properties.
- Select the tab "Advanced"
- Check the box "Run this program in compatibility mode" and choose here "Windows 2000".

If you fail to adjust this setting the programme will lock up after a OML computation.
In that situation you will have to use Ctrl+Alt+Delete in order to get any further.

See also Computer-related hints

File types

See also: File names assigned to the project | New project | Open project | Save project as | Copy files

It can be useful to know the file types OML-Multi deals with:

- **PRJ**: Project file, which contains the names of files belonging to the project.
- **OPT**: Settings for calculations. Contains information which is entered in the window Special settings

- **RCT**: Receptor and terrain data.
- **KLD**: Data for point sources with constant emission. KLD- and KBG files normally accompany each other (when one is saved or copied, the other is also)
- **KBG**: Data for ddb point sources with constant emission. KLD- and KBG files normally accompany each other (when one is saved or copied, so is the other).
- **EMS**:Time series of emission data for point sources. EMS-, TIM- and TBG-files normally accompany each other (when one is saved or copied, so is the others).
- **TIM**: Constant data for point sources with emission given as a time series. See EMS
- **TBG**: Data concerning ddb for point sources with emission given as a time series See EMS.
- **ARE**: Area source data.
- **MET**: Meteorological data. See also:
  Meteorological data
  Resolution of wind direction data.
  New format for the meteorological file
- **LOG**: The principal output file. Contains an overview of input data, a log of the run, tables with output and error messages. The information presented to the user via the ***Results*** window is extracted from this file.
- **DAT**: Data file created by OML-Multi. Its contents depends on user settings, but it may contain time series of concentrations or exported concentrations.
- **CSV**: Data file (Comma Separated Format). Used when importing source data.

See also
Computer-related hints
Default Folders

Default folders:

On a PC with English operating system OML-Multi is by default installed in the folder

C:\Program Files\OML-Multi

The subfolder **C:\Program Files\OML-Multi\Samples** contains samples.

The folder **C:\OML_data** is meant for the user's own projects.

Sample files, overview

During a standard installation OML-Multi will be installed in the folder **C:\Program Files\OML-Multi** (see default program folder).

The subfolder **Samples** contains files with examples.
.

Issue illustrated	File name
The files with name *Example.** represent a simple example of OML input files. How to use the Example files	Example.*
Files illustrating import of source data, both for point and area sources. See the topics *Import point sources and Import Area sources*	Point Sample.csv Point Sample.xls Area sample.csv Area sample.xls
Files illustrating a time series of emission data. See the topic *Time series, emission data*	Timeseries sample.ems Timeseries sample.tbg Timeseries sample.tim
Sample of file with background data. See the topic *Background levels*	NOxNO2O3 Test.dat

A 'Line draw file' used to produce lines on a graphical presentation of concentration levels. See the topics *Graphical output* and *Line draw file* as well as the information given below on 'Example 2' files.	LineAndBox.dat
Files with names *Example 2.** represent a simple example of OML files constructed to be used in conjunction with the file *LineAndBox.dat*. The file is used when presenting results graphically, and contains an example of the use of lines to indicate company property border lines and roads. See How to use the 'Example 2' files	Example 2.*

How to use the Example files

Files with the name Example.* represent a simple example of OML input files.

The files can be used in the following way:

Copy the Example files to a folder of your choice, e.g. to C:\OML_data (using Explorer)

Open the project Example.prj.

Use the button **Common names** (you will receive a warning that the folder *C:\Some_folder* cannot be found, but just click OK).

Navigate to the folder where you copied the files.

Choose Example as a common name for the files.

You can now proceed with a set of calculations.

See also:
Sample files, overview
Recipe: Files have been moved

How to use the 'Example 2' files

The files called Example 2.* constitute an example of OML input files that are specifically constructed to be used in conjunction with the file LineAndBox.dat

The file LineAndBox.dat is a Line Draw file . It contains an example of lines, which indicate the borders of a company property, as well as a few roads.

The files can be used in the following manner:

Copy the files Example 2.* and LineAndBox.dat to a folder of your choice, e.g. to C:\OML_data (use Explorer when copying files).

There is no project file called Example 2.prj.

Therefore, you will have to define a project file. Create a new project in the chosen folder and call it Example 2.

When you open this new project, the Example 2 files will automatically be associated with the project.

You can save the project, carry out calculations, and then inspect results using the graphical output facility.

When displaying results graphically (having used menu Results | Graphic and chosen a table) you can click the button labelled *Liniefil* (Line Draw file) and browse to the file LineAndBox.dat.

See also:
Line draw file
Graphical output
Sample files, overview

Help text in printed version

From the Help window you can print each single topic separately. You can get an overview of all topics by using the button

in the menu bar (or here).

However, it is also possible to print all topics at once. They are gathered in a single file, All_help_texts.pdf. Depending on your version of the OML programme you may find the file in the default folder for OML-Multi, typically C:\Program Files\OML-Multi. In any case, you can download the latest version of the file from the Internet, *http://www.oml-international.dmu.dk*

See also

Computer-related hints

Help window: Make it fit your needs

Normally, the window with Help text will slide into the background if you make another window active.

If you wish to keep the Help window in front, you can - when positioned in the Help text - right-click and select Keep Help on top

Further, you can adjust size and position of the windows both in the OML programme as of the Help text.

You can adjust the font size of the Help text by right-clicking and selecting Font

See also

Help text in printed version

Computer-related hints

System requirements and calculation speed

The following equipment is required in order to run OML-Multi:

- A PC with a Pentium processor (or compatible)
- Windows 9x, Windows ME, Windows 2000 or Windows XP.
- 10 MB free disk space
- 32 MB RAM
- CD-drive (for installation)
- A screen with a minimum resolution 800 x 600 can. It is recommended to use a higher resolution, however.
- When installing under Windows 2000 or Windows XP administrator privileges are required. The program can be installed so it is accessible for a single user or for all users of the machine.

Concerning network: The program should be installed locally on every machine where it is used

An important hint concerning Windows XP: It is necessary to adjust a setting concerning 'compatibility mode'

Calculation speed

A calculation with OML-Multi for a single source, one year of data, takes less than 10 seconds on a 1.5 Ghz Pentium.

Calculation times are increased almost proportionally with the number of sources and the length of the calculation period.

See also Computer-related hints

Language

The OML-model allows the user to choose between English and Danish language.

Note that there are two settings which are independent of each other: Settings concerning ***the menus*** and concerning ***the printed output.***

Concerning the menus:

You can change language in the menus of OML by using the menu **Files / Language**.
The newest version of the English Help text can be downloaded from *http://oml-international.dmu.dk*

Concerning printed output:

The language in the results from OML-Multi is independent of the language in the menus. It is controlled through the window Special settings

See also Computer-related hints

License key

The OML CD contains a licensing key with the user's company name. The original CD should be kept in a safe place, because it will be needed if you change computer, and possibly also for certain upgrades of the product.

When the programme is once installed, upgrades of the program will normally take place without any need to worry about the license key.

Licensing conditions

The licensing conditions resemble those of many other programs. However, note the conditions concerning the number of users for one license:
The license is for a specific physical location.
The licensing conditions for OML-Multi gives the licensee right to use any number of copies of the program on any number of PC's, as long as they are physical present at the address of registration; also included by the license are portable and home computers for employees working at the specified address.
Note that a company having branches at several physical locations is required to have separate licenses for each branch where the program is applied.

You will find the full licensing conditions in the document ***License.doc*** which is located in the default program folder

See also Computer-related hints

PDF-format

In order to open files in PDF format (Adobe Portable Document Format) Acrobat Reader is required.
Acrobat Reader (version 5) can be installed from the OML CD.
The installation program is found in the folder Acrobat as the file ar500enu.exe.
You can install Acrobat Reader by double-clicking the file name ar500enu.exe

Manually created files

If you bypass the menu system, and edit or create a file manually, you should be aware of the following potential problems:

- Files should be in pure text format (ASCII). Word processors (like Microsoft Word) do not by default save files in this format, but can be forced to do so (through their "Save As" feature). However, the most unproblematic procedure will be to use an editor like Notepad.
- Errors may occur, if manually created files contains tab characters instead of spaces. Certain editors can be configured to convert spaces to tabs, and such behaviour in undesired (Notepad gives no problems).
- Certain old editors (e.g., the DOS program Personal Editor) puts an extra character at the end of the file, and this can cause an error.

You will need to create a file manually if you wish to work with an irregular receptor grid that is neither rectangular or circular See Irregular receptor grid

Problems

Reporting problems

If you encounter errors when working with OML-Multi, then check at the OML web site

http://oml-international.dmu.dk.

whether the problem is known.

Problems can be reported to NERI (contact persons: Per Løfstrøm, pl@dmu.dk and Helge Rørdam Olesen, hro@dmu.dk)

Known problems:

- If you use **Windows XP** you must once and for all adjust a certain setting concerning 'compatibility mode'. More...
- If you use **Windows 2000** and accidentally click in the black command window when performing OML calculations, the calculations will pause. You can continue by right-clicking or by pressing any key.
- The message: No files to copy!

See also

Version history

Computer-related hints

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Message: No files to copy !

If you get the message **"No files to copy !!!**" it may be because the project you wish to copy from isn't consistent.

Chances are that the project file refers to some files which are not found in the expected locations.

See also: Recipe: Files have been moved

Error concerning area sources

This topic is omitted from the English version of the help text. It concerns an extremely rarely occurring bug which was corrected in version 5.02

See also: Version history

Version history

OML-Multi **5.00** was released in **October 2002**.

Version 5.01 was released in **November 2002** and implemented minor improvements in the menu system:

- the window ***Results:*** When sending a print to a printer you get a receipt.
- the window ***Results*****:** The option *Project name on first page* introduced. .

- the window ***Calculations and settings:*** A warning is issued before a file with results is overwritten.
- ***Menu with Graphical presentation****:* Improvements in the lead text.

Version 5.02 was released in **February 2003**. Minor cosmetic changes, plus two changes with a possible effect on some results:

- Assuring that old input files for version 4.2 are imported correctly, irrespective of the units used.
- A very rarely occurring error related to area sources has been corrected.

A new install routine implemented, so users more easily can upgrade using the Internet.

Version 5.03 was released in **March 2003**. An minor error in the print of source data has been corrected.

The English help text was not fully translated when the Danish version was released, but has been revised several times since then.

The current version is from December 1, 2005.

See also: Version number

Glossary

Here is a brief explanation of certain terms used in relation to OML-Multi.

The best way to learn about other terms is the use the search faciliity of the Help text (the button **Index**, tab **Index**).

- **Area source:** Examples of area sources are: emission from a storage basin; emission from an area where several small sources are evenly distributed. See Area sources
- **C-value:** A limit value used in Danish regulations. At the end of OML calculations, the model can summarise concentration values for all receptors and all hours in the year in the form of one, single number: the maximum of monthly 99-percentiles This number is compared to the so-called *C-value* for the substance in question. See the Danish Air Emissions Guideline.
- **Receptor:** Point where calculations are made. See Receptors menu
- **Roughness length**: Parameter expressing the overall roughness of the terrain. The user must specify a value for the calculation area. Often, a value of 0.1 m is used in the countryside and 0.3 m in urban areas. The roughness length also appears in the context of the meteorological input file. That value can be different from that of the calculation area. See Circular grid, Roughness length

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