OML-Multi 7.0
– getting started

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Introduction

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 OML model is maintained by Aarhus University (AU) in Denmark. The model was originally developed by the National Environmental Research Institute (NERI), which in 2007 became part of Aarhus University.

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. The model is used to demonstrate that planned facilities comply with the *Danish Guidelines for Air Emission Regulation*. Furthermore, the model is used in the context of the regulations concerning *Approvals for Livestock Holdings.*

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

OML-Multi version 7 has a major new features compared to previous versions. It is now possible to perform ammonia deposition calculation from animal housing. This feature is closely connected to Danish EPA's regulation and guidelines. These menus are currently only in Danish language. As in previous versions, it is possible to perform calculations for a 10 year time series of meteorological data. This is of particular interest in the context of the Danish regulations concerning Approvals for Odour from Livestock Holdings. Further, it is possible to use OML-Multi for simple deposition estimates. This is of particular interest in relation to so-called "VVM assessments" (Environmental Impact Assessments of large projects) in respect to impact of new facilities on terrestrial and aquatic ecosystems.

Use the help facility!   The user interface is in English. The user can switch to Danish if desired. There is a help facility within the programme. **It is highly recommended to make extensive use of the help facility**. The present *Getting Started* guide is quite brief, whereas the help facility contains much more detailed information.

You can download updates to the programme and the help text at the web site
http://www.au.dk/oml-international

System requirements

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

- A PC with Windows operating system (Windows 7, 8 or 10).
- 150 MB free disk space.
- Possibly a DVD drive (depending on the media for the OML package)
- A screen with a minimum resolution of 800 x 600. It is recommended to use a higher resolution, however.
- When installing the software 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.

Installation

Media

The OML model is delivered as a package of files, here referred to as the "OML package". The package can be delivered on one of several media: CD/DVD, USB key or as downloaded zip file.

All three types of media have the same content, which usually includes a license key (a file which is specific for each user and contains company address etc.). In some cases, the license key is delivered separately. The license key is typically located in the folder "License" in the OML package.

First-time installation

You must be logged on your operating system with administrator privileges.

- Close running programmes.
- The next step has slight variations depending on the media:
  - **DVD**: Insert the OML DVD. Normally, installation will automatically begin.
    Otherwise: Select **Start / Run** and write **D:setup.exe** (assuming that your DVD drive is D:).
  - **USB key**: Open the contents of the USB key and doubleclick Setup.exe
  - **Downloaded Zip file**: Unpack the zip file (OML package) in a location of your choice on the hard disk or network drive. E.g., you may unpack them to a new sub folder named *OML-Multi-Installation* in your user folder (c:\users\<username>). After unpacking the files doubleclick Setup.exe.
- Follow the instructions on screen.
  On most PC's, installation takes only a couple of seconds.
  After installation an icon for OML-Multi 7.0 becomes available on your desktop. Furthermore, OML-Multi can be accessed from Start / Programs.

Assigning a license file
- When you start OML-Multi for the first time you must assign a valid license file to the programme. Go to the menu *Help* and choose *Change user license*. This allows you to navigate to the location of your license file. Typically, it is in the folder *License* within the OML package (you may also have received it by mail).
- When you use the programme it is pertinent to place your own data in a folder for that purpose. During installation such a folder is created – by default as *C:\OML_data*.

Optionally install Adobe Acrobat

If you haven't installed the program Adobe Acrobat Reader, it is recommended that you do so. Some supplementary material concerning OML in is in PDF format, and the Acrobat programme or an equivalent app is necessary in order to read such files.

Supplementary material

There is various supplementary material (such as reports with guidance on regulatory use of the model, some of them in Danish) in the OML package in the folder *OML_Supplement*. This material is not installed on your hard disk, but you may copy it if you wish. In the folder there is a file called *Overview.txt* describing what is available. (Furthermore, the help text topic *Supplementary information* also provides such a description).

Meteorological data

When you install the program, two sets of meteorological data from Denmark will be copied to your hard disk.

For ammonia deposition from animal housing 10 more special formatted datasets from Danish locations covering 10 years are also installed. These are only intended to be used in this connection.

International users of OML-Multi may find other meteorological data sets in the OML package in the folder Met_data. 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 – see the section "Getting started" for details.

Upgrading OML-Multi

If you have an existing installation of OML-Multi you can proceed in the same way as for a first-time installation. The previous version will be uninstalled if required. Such uninstallation will not affect any data files you may have created yourself.

Setup files with small upgrades to the program may become available through the Internet at http://www.au.dk/oml-international

License key

Keep the DVD in a safe place

The OML package normally contains a licensing key with the user's company name. The OML package including the license key should be kept in a safe place, because it may be needed for later upgrades or reinstallations of the product. In the chapter *Installation* it is explained how to assign the license key to the program.

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.

Getting started

Example, step by step

You can get started with a set of '*Standard OML*' computations by following the steps outlined below. Computations for '*Husdyrbrug, NH3*' (animal housing) is not explained, because the menus are currently in Danish. There is further explanation in the Help text under the heading "Getting started".

- Start OML-Multi by double-clicking the OML-Multi icon on the Desktop.

- Select **Files|New project|Standard OML**. 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 (recommended order) before you can make a set of calculations.

- Select **Sources| 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", which is available through the help text. 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. For the entered emission (*Sources*) the centre of gravity is shown as suggestion for centre of receptor grid.
   When you're done use *Save*.

- Click **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.

Use of local meteorological file

Danish users will typically not need to worry much about the meteorological file, because the OML model comes bundled with two standard sets of data which is normally used for regulatory purposes in Denmark. One set is a meteorological time series with one year's worth of data (the year of 1976 from the airport of Kastrup), and the second a time series with 10 years of data (airport of Aalborg, 1974-83). For stack height determination of industrial stacks according to the Danish *Guidelines for Air Emission Regulation* the set of one year's data is normally used, whereas for calculations related to odour regulations concerning *Approvals for Livestock Holdings* the 10-year series has come into use from 2014 (concurrently with version 6.0 of OML-Multi).

For the specialised computations for Danish '*Husdyrbrug, NH3*' (animal housing) 10 special Danish meteorological datasets are also supplied.

Users outside of Denmark will need a pre-processed meteorological data set representing local conditions. The OML meteorological pre-processor can generate such data from measured meteorological data (there is more information in the help text). Alternatively, a meteorological model such as WRF can be used to create the necessary data, or data originally prepared for other dispersion models can be converted to OML format. Such data generation or conversion software is not part of OML-Multi. You may enquire about current possibilities.

International users of OML-Multi may find relevant meteorological data sets in their OML package in the folder *Met_data*. They will also find a *Readme* file.

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" window are correct with respect to resolution of wind direction and meteorological year. This information appears from the relevant readme file for the meteorological file.

You can find the Special Settings window by selecting **Calculations,** and then click on the "Special settings" button.

Appendix

Handling the influence of buildings in the OML model

What is the background for building effects?

Buildings have an impact on plume dispersion

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.

For this reason, the OML model requires information on buildings close to the stack.

Building effects are complicated

The present note contains some general guidelines on preparing input data concerning buildings to the OML model. Nevertheless, the effect of buildings on the dispersion of pollution is a very complicated subject, which is very difficult to handle in general, partly because the effect of a building depends on its shape and location. The methods suggested are therefore encumbered with a considerable uncertainty; the aim is to provide means for calculation of concentration values, which represent a fair first approximation to reality. By other, more detailed analyses of concrete cases, more precise results may be achieved. In particular, computed concentrations quite close to buildings should be treated with caution (see the section on the main principles).

Overview

The note discusses the following subjects:

- A checklist for the practical approach to be taken when preparing building information for the model. When you follow the checklist, you will need the detailed information presented in the subsequent sections.
- The concept of *Effective building height*, which is relevant for narrow buildings.
- Identification of buildings, which have an influence on dispersion.
- The concept of *General building effect*, which is relevant for buildings located adjacent to a stack.
- The concept of *Direction-dependent building effect*, which is relevant for buildings located at some distance from a stack.
- The main principles concerning handling of building effects in the OML model.

The precise meaning of certain terms in the following should be clearly understood.

By the term *stack height* is meant the height of the stack top above the ground.

By the term *distance to a building* (from a source, in a given direction), the distance considered is that *along the direction in question, to the closest point on the building*.

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Checklist for the practical approach when specifying building parameters to OML

For details, see the following sections

It is recommended to 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 a protractor to measure angles.

You must consider the stacks one by one, and for each stack determine which buildings are relevant and find the corresponding input data.

Is it necessary to include the building?

It is necessary to include the building only if *all of the following criteria* are fulfilled (H_B is the "effective building height"):

- The (closest part of) the building must be closer than $2\,H_B$ to the stack.
- The building (H_B) must be higher than 1/3 of the stack height.
- As seen from the stack, the building must occupy an angle of more than 5 degrees.

Determine descriptive parameters for each building:

For a building just beside or under the source, i.e. "general building effect":

- Check whether the building – as seen from the source – has an angular extension of more than 90 degrees. In that case it has a "general effect".
- Determine the effective building height H_B, and provide it as input to the OML model.

For buildings that are not very close to the source, i.e. direction-dependent building effect:

- If the building covers an angle of less than 90 degrees find the directions from the source to the edges of the building. For directions pointing towards the building, provide the distance and effective building height as input to the OML model.
  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.

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Further explanation of the steps of the checklist

In the checklist above, the concept of "Effective building height" (H_B) is used. This is explained in the following. Other aspects of the approach are also explained in more detail.

Effective building height (H_B), which is relevant for "narrow" buildings

Effective building height, H_B

Consider a stack, which is adjacent to a building (for instance on top of the building). The concept of an *effective building height H_B*, which remains to be defined, is introduced because narrow buildings have less influence on the flow than wide.

For wide buildings there is no difference between physical and effective building height.

For wide buildings no distinction will be made between the physical building height H_P and the effective building height H_B; they are identical. For narrow buildings – that is buildings, which have a height larger than their width L – the effective building height is defined as

$$H_B = 1/3 \ H_P + 2/3 \ L$$

Thus, for a narrow building the effective building height is smaller than its physically height.

The effective building height is used both when dealing with a general building effect and when dealing with a direction-dependent building effect.

Building width L

The building width L is defined in the following manner. The width depends on the angle from which we consider the building. When positioned at the source, we can look at the building from different directions – e.g. in a direction as shown in the figure below (the building is seen from above).
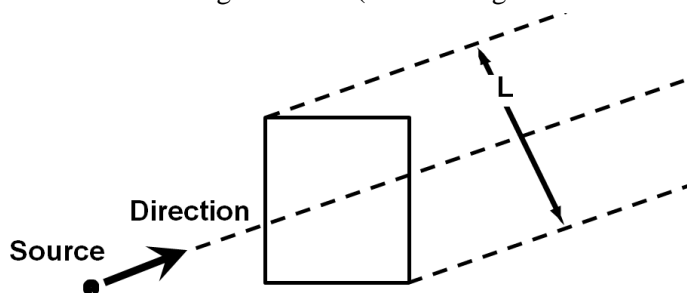

Figure 1. Illustrates L: The width of the projection of the building along the wind direction.

L is the projected width of the building. L will have a different value for other directions.

L may often be calculated as the diagonal

If the stack is located at top of the building or juxtaposed to it, the so-called *general building effect* is acting – there is an effect of the building, no matter from which wind direction the wind comes. In such cases we consider *only one L value is relevant, namely the diagonal of the building* (the maximum projected width of the building).

When it comes to buildings located at some distance from the source, the methods for determination of L is discussed in a later chapter on *direction-dependent building effects*.

Identification of buildings, which have influence on the dispersion

To prepare input data concerning building effects, start by drawing a sketch of the stack(s) and buildings.

For each stack, identify all buildings that are closer to the stack than the distance $2 \ H_B$ (effective building height). Only these buildings have an influence on the dispersion of the plume. Further, buildings can be disregarded if their height (effective building height) is less than 1/3 of stack height. Finally, buildings can be disregarded, if they occupy an angle less than 5 degree - as seen from the stack.

No harm is done, however, if the user enters data for a building which is too far away or too low to influence dispersion; the building will be neglected in the model calculations.

General building effect

When input data to the OML model are prepared, it is necessary to distinguish between buildings situated quite close to the source and buildings at some distance. Buildings nearby have an influence on the plume dispersion in all wind directions and this is a *general* effect; the other category has a *direction-dependent* effect.

Both effects can take place simultaneously.

The 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.

When the OML model requests specification of a "general building height", the user should enter the effective building height if there is any building exerting such general effect. If the stack is far away from buildings, or the buildings are lower than 1/3 of the building height, the user can enter zero for its height.

Direction-dependent building effect

The OML model is able to handle the influence from buildings at some distance from the source, the so-called "direction-dependent building effect".

Consider the situation from the source. For each direction where a building is located the user has to specify the *distance to the building* from the source and the *effective building height*. For narrow buildings the user must determine the effective building height by using the formula indicated earlier:

$$H_B = 1/3\ H_P + 2/3\ L$$

However, here L is the projected width of the building *in the current direction*, and not necessary the diagonal of the building. You do not have to make a precise calculation of L for every direction, but may use the same value for several directions.

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.

Values for directions 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.

Background information: The main principles concerning handling of building effects in the OML model

In the OML model it is assumed that a building with the height H_B (effective building height) creates a flow field (domain of influence), which extends a distance of $2\ H_B$ downwind from the building. If the stack is located within the influence domain of the building, then the building has an effect on dispersion. If the stack located outside the influence domain of the building, then the building has no effect on dispersion.

Internally in the OML model, the height of the plume centerline above a certain point P is evaluated. There is such a point P for every direction with a

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10-degree interval; once the geometry of the buildings surrounding the source has been defined, the positions of all points P can be determined. P is determined for all 36 wind directions, and it is located either at the downwind edge of the influence domain (2 H_B from the building), or - if the stack is located downwind of the building - at a distance of 2 H_B from the stack.

If the plume at the point P has a height larger than 3 H_B, then the plume remains unaffected by the building; otherwise, influence will take place. The influence is partly simulated by a reduction of the plume rise and partly by an increase of the dispersion parameters - primarily the vertical dispersion parameter.
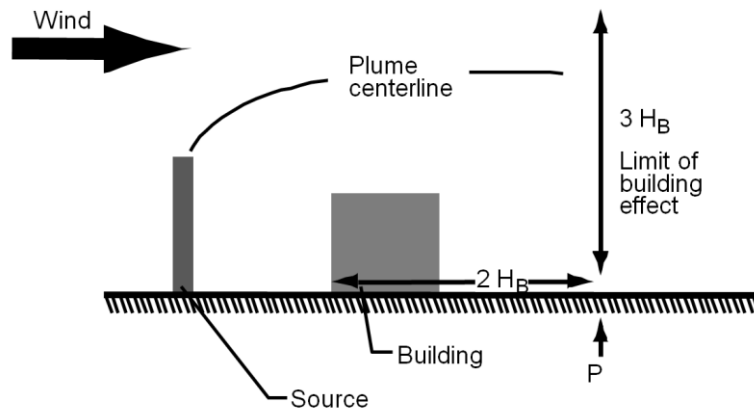

Figure 2 Sketch, which illustrates 'influence domain' (marked by the horizontal double arrow) and the location of the point P where the plume height is estimated.

Don't rely too much on computed concentrations quite close to buildings

Very close to buildings OML does not attempt to calculate concentrations accurately. Instead, when a receptor is closer to the stack than the point P, the concentration output from OML is "artificial" as it is just set equal to the concentration at the point P. Thus, for each wind direction the outputted concentrations are constant from the source to the point P. In lack of any better method, these prescribed concentrations can be regarded as an indication of the actual concentration near the source. In this type of situation OML-Multi will give a warning that a receptor is located close to a building in its domain of influence, and that results are not reliable.