



USER GUIDE TO OML-HIGHWAY

Technical Report from DCE – Danish Centre for Environment and Energy

No. 59

2015



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Data sheet

Series title and no.:	Technical Report from DCE – Danish Centre for Environment and Energy No. 59
Title:	User Guide to OML-Highway
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Institution:	Aarhus University, Department of Environmental Science
Publisher:	Aarhus University, DCE – Danish Centre for Environment and Energy ©
URL:	http://dce.au.dk/en
Year of publication:	July 2015
Editing completed:	July 2015
Referee:	Ole Hertel
Quality assurance, DCE:	Vibeke Vestergaard Nielsen
Financial support:	Danish Road Directorate and DCE
Please cite as:	Olesen, H.R., Ketzel, M., Jensen, S.S., Løfstrøm, P., Im, U. & Becker, T. 2015. User Guide to OML-Highway. A tool for air pollution assessments along highways. Aarhus University, DCE – Danish Centre for Environment and Energy, 66 pp. Technical Report from DCE – Danish Centre for Environment and Energy No. 59 http://dce2.au.dk/pub/TR59.pdf
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Abstract:	OML-Highway is a user-friendly GIS-based model for assessment of air quality along motorways and other main roads in open terrain. The user guide gives a brief introduction to OML-Highway and describes its use. It contains a detailed description of the various menus and their application. Further, it contains an appendix with reference material.
Keywords:	OML-Highway, atmospheric dispersion model, OSPM, GIS, SELMA ^{GIS} , highway, motorway, traffic pollution, air quality.
Layout:	Majbritt Ulrich
Drawings:	Helge Rørdam Olesen
Front page photo:	Danish Road Directorate
ISBN:	978-87-7156-150-0
ISSN (electronic):	2245-019X
Number of pages:	65
Internet version:	The report is available in electronic format (pdf) at http://dce2.au.dk/pub/TR59.pdf

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Summary

OML-Highway is a user-friendly GIS-based model for assessment of air quality along motorways and other main roads in open terrain. A common application of OML-Highway is for assessment of air pollution in environmental impact assessments of new major roads or major alteration of existing roads. OML-Highway has been integrated into SELMA^{GIS}, a GIS environment developed by Lohmeyer GmbH & Co. KG, Germany.

SELMA^{GIS} is a framework which is used for running various dispersion models, including OML-Highway. It requires the GIS software ArcMap marketed by the company ESRI.

The present user guide provides a brief introduction to OML-Highway and to the central concepts in the model. It further describes the procedure and requirements for installation.

A central part of this user guide is the chapter *Working through the menus*, which gives a detailed description of the various menus and their application.

A detailed description of the various files handled in a OML-Highway project is provided in Appendix to the report.

1 Introduction

OML-Highway is a user-friendly GIS-based model for assessment of air quality along motorways and other main roads in open terrain. It is based on the OML model (Olesen et al., 2007) which is designed for air quality assessment based on point and area sources. In the OML-Highway model, road sources are represented as area sources. The parameterisation for the initial dispersion is based on the formulation in the Operational Street Pollution Model (OSPM; Berkowicz, R., 2000), but is slightly modified in order to better represent the conditions at highways. In OML-Highway, traffic produced turbulence (TPT) is depending on traffic intensity, type of vehicles (light and heavy-duty vehicles) and travel speed. This is similar to the OSPM model, but in OML-Highway the TPT decays in an exponential manner with distance from the road. OML-Highway has been successfully evaluated against measured datasets from Denmark (Jensen et al., 2004; Wang et al., 2010) and Norway for the pollutant of NO_x (nitrogen oxides, the sum of NO and NO₂), and it has also been compared to other similar models (Berger et al., 2010).

A common application of OML-Highway is for assessment of air pollution in environmental impact assessments (EIA) of new major roads or major alteration of existing roads according to EU directive on EIA. A report from 2010 (Jensen et al., 2010) and a short paper (Jensen et al., 2012) describe the potential applications of OML-Highway and its integration into the SELMA^{GIS} framework. A guidance report from the Danish Road Directorate (Jensen et al., 2013) provides recommendations on the application of OML-Highway for air quality assessments. There are a number of reports describing projects with application of OML-Highway for EIA of major roads (e.g. Jensen et al., 2011a; 2011b; 2011c; 2015).

OML-Highway has been integrated into SELMA^{GIS}, a GIS environment developed by Lohmeyer GmbH & Co. KG, Germany SELMA^{GIS} runs as an extension to ArcGIS (Jensen et al., 2010). that is a suite of geospatial processing programs marketed by the company ESRI. ArcMap is the main component of this suite.

SELMA^{GIS} is a framework which is used for running various dispersion models, including OML-Highway. The purpose of SELMA^{GIS} is to integrate sophisticated dispersion models into a framework with the capability to prepare input data and analyse model output by utilising the spatial capabilities.

Many aspects of file formats and preparation of input data in OML-Highway rely on the procedures used in the street canyon model WinOSPM®. WinOSPM is a user-friendly version of the above mentioned OSPM; for the sake of brevity, the abbreviation OSPM is often used in the following even in cases where WinOSPM would be more correct. OML-Highway is accompanied by a limited version (or, optionally, a full version) of WinOSPM®. The limited version gives access to various utilities for data preparation, as emission calculation and traffic editor, but not to run WinOSPM.

OML-Highway requires as input a digital GIS road network with traffic data (average daily traffic, travel speed, and share of heavy-duty vehicles). Based on this data OML-Highway is able to automatically generate emissions by use of the European emission model COPERT IV, which is integrated into the OML-Highway model. Emissions include NO_x, NO₂, PM exhaust, PM_{2.5}, PM₁₀, CO and CO₂ (based on fuel consumption; PM exhaust is particulate matter from car exhaust, PM_{2.5} particulate matter smaller than 2.5 micron, and PM₁₀ particulate matter smaller than 10 micron). The digital road network has to be divided into “target roads” and “background roads” by assigning an attribute. Target roads are typically roads for which the user wants to calculate air quality along the road at specified receptor points. The target roads are automatically subdivided into elongated rectangular area sources. The background roads are all other roads that contribute to the background levels at the target roads. The user can specify a user-defined grid (typically 1 x 1 km²) to automatically calculate the emissions from the background roads, where the emissions subsequently are aggregated within grid cells. The purpose of this aggregation is to reduce the number of individual sources and herewith the calculation times to a reasonable amount. As further input, the OML-Highway model requires time-series data for regional background concentrations.

In addition to traffic sources, emissions from other sources can also be imported.

OML-Highway requires processed meteorological data, which can be provided by the OML meteorological preprocessor. This preprocessor calculates turbulence parameters based on, e.g., synoptic and upper air data. A user-friendly simplistic special version of the OML meteorological preprocessor has been integrated into the OML-Highway model a version of the meteorological pre-processor that only requires synoptic data. Alternatively, the user can provide his own meteorological data, e.g. from a meteorological model.

The OML-Highway includes simple photo-chemistry and is able to model NO₂ taking into account chemical transformation between NO, NO₂ and O₃.

The model includes algorithms that enable modelling of the effects of noise barriers on the dispersion of air pollution. The user has to specify the height and location of the noise barrier.

Several tools are implemented into the user interface of the model that makes it easy to generate receptor points e.g. along target roads in certain distances or import receptor points that represent all buildings within a certain area e.g. as address points.

The calculation time step in the model is one hour, and model results may be time-series or various statistical parameters like annual mean or percentiles. The model can estimate concentrations of NO_x, NO₂, O₃, number of particles, PM_{2.5}, PM₁₀ and CO, provided that regional concentrations are available for these pollutants.

Projects that have contributed to the development of OML-Highway have been funded by the Danish Road Directorate and DCE – Danish Centre for Environment and Energy at Aarhus University.

The present user guide describes the version of OML-Highway available in May 2015, more specifically SelmaGisExt.dll version 9.29.4.5 (26-11-2014) and OMLHighway.dll version 1.1.19.1 (26-11-2014; section 5.2 explains how to find such version numbers). Furthermore it is based on the use of ArcMap 10.

In order to check whether you have the most up-to-date documentation you should consult the web page for OML-Highway, www.au.dk/OML-Highway. In future you may also find a more up-to-date guide than the current user's guide in the built-in help system of SELMA^{GIS}, which is accessed from the SELMA^{GIS} menu.

The structure of the report is as follows:

- Chapter 2 describes concepts in OML-Highway. A first-time user of OML-Highway should get acquainted with the concepts of Target roads and Background roads explained in this chapter, but can then jump to the next chapters on installation and "Getting started".
- Chapter 3 describes the installing procedure and the requirements for installation.
- Chapter 4, *Getting started*, is a short introduction for the first-time user. It briefly presents a set of sample files accompanying the software package.
- Chapter 5, *Working through the menus*, gives a detailed description of the various menus and the questions related to them.
- Chapter 6 contains references.
- The Appendix, numbered chapter 7, contains reference information. There are many different types of files involved in an OML-Highway project. The chapter presents both an overview and details on the contents of the various file types. Note that section 7.2 "Guide to file extensions" is very useful as a reference.

2 Concepts in OML-Highway

This chapter outlines various concepts, which we refer to in the following description of parameters and files. If you are a first-time user of OML-Highway you should browse through the input requirements below and get acquainted with the concepts of Target roads and Background roads explained in this chapter. You may then jump to the next chapters on installation and “Getting started”. However, you will need later to return to the description of concepts.

2.1 Input requirements

Below follows a summary of files to be provided by the user. If these files exist, all remaining files can be generated during a SELMA^{GIS} session.

- One or two road network shapefiles, which describe roads referred to as “target roads” and “background roads”. These concepts are further explained in the next sections. The files contain records describing road segments. Road segments are characterized by a large number of attributes, the most important of which are Annual Average Diurnal Traffic (AADT), the share of heavy duty traffic, and average travel speed. Road network shapefiles and their attributes are described in more technical detail in the Appendix, section 7.3.1.
- A file with regional background concentrations. See section 5.8 and the Appendix, section 7.3.6 concerning content and format.
- A meteorological data set with hourly data (typically for a year). See section 5.9 and the Appendix, section 7.3.8 concerning content and format.
- Other background emissions if any. See section 5.6 concerning content and format.
- Files containing information on emission from traffic. There are several such files (having extensions *.trf, *.vlf and *.flf). A set of these files exist for Danish conditions, but users elsewhere must make adjustments to reflect the situation in their country. There is some information on these in the remainder of the present chapter, but for full details you must consult the manual for WinOSPM.
- A *.deb file (“Diurnal Emission Background file”). It provides information on the diurnal variation of emissions from the background roads. There is a sample *.deb file provided with the installation package, which may be acceptable for direct use, also for non-Danish users. See section 5.5.3 and the Appendix, section 7.3.5.

2.2 Target roads, background roads and receptor points

Figure 2.1 illustrates some basic concepts in the use of OML-Highway.

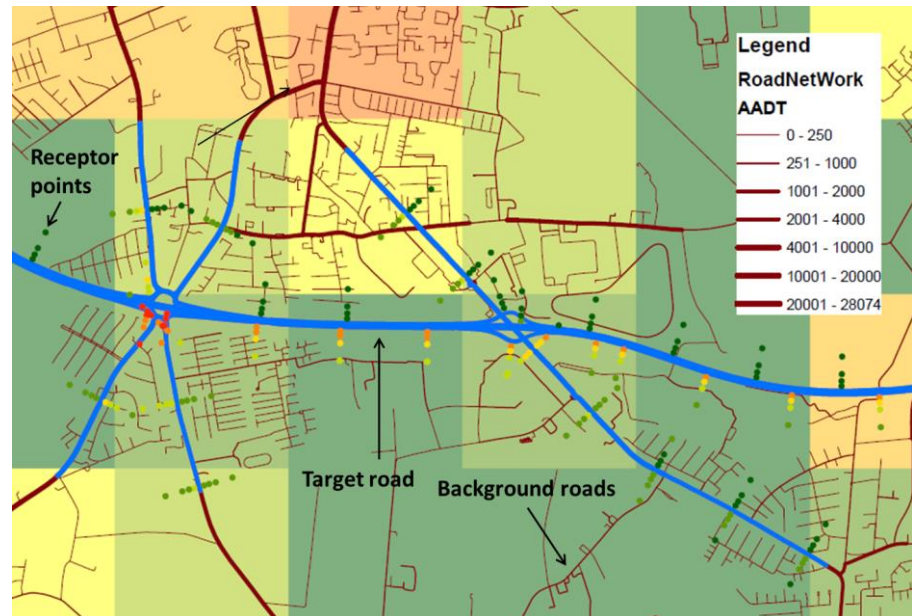


Figure 2.1. Target roads, background roads and other basic concepts. In the example presented here target roads are shown as blue lines, while background roads are brown lines (of various widths). Line width indicates the traffic volume on each road, both for target roads and background roads. In this example receptor points (calculation points) are placed in short series of points perpendicular to the target roads. The emissions from background roads only (aggregated in a 1km x 1km grid) are shown as coloured squares.

“Target roads” are roads where detailed traffic information is supplied, and along which detailed information on concentrations is requested – e.g. a highway, which is the subject of an environmental impact assessment.

“Background roads” are other roads. Detailed information for such roads may be supplied, but only a limited amount of detail is carried on and used in the calculations. The software aggregates emissions from the individual background roads to yield a field of emissions for cells in an "emission grid". The cells can, e.g., have a size of 1 km by 1 km. In Figure 2.1 the coloured squares represent cells in an emission grid, and the colour coding depicts the background emission level in each cell. The purpose of this aggregation is to reduce the number of individual sources and herewith the calculation times to a reasonable amount.

Concentrations are calculated in receptor points, the location of which can be specified by the model user. Several tools are available for generating data sets with receptor points. An often used tool within the software allows the user to generate receptor points along target roads, at various distances from the road, as indicated in Figure 2.1.

2.3 Road source geometry

A road can be represented as a single line or “double digitized”, i.e. as two parallel lines which represent the two traffic directions separately.

During the process of preparing data for use in OML-Highway, a road is automatically divided into multiple segments, where each segment is approx-

imated by a rectangle. This rectangle is a so-called “area source”, which emits pollution uniformly over its area. Such rectangles may be rotated at any angle with respect to North, as illustrated in Figure 2.2.

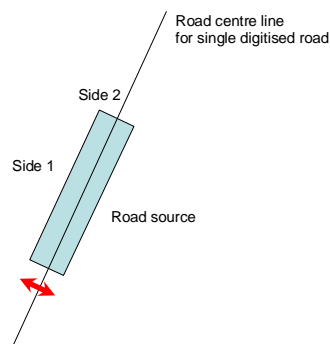


Figure 2.2. An area source (road segment) in OML-Highway. It is characterised by the coordinates of the most westerly corner and the lengths of two sides. The convention for numbering the sides is as follows: From the corner, go along the circumference of the rectangle in a clockwise direction. You will first meet "Side 1", then "Side 2".

Road segments have a unique ID number. For double digitized roads the software keeps track of the ID of the opposite road segment as illustrated in Figure 2.3.

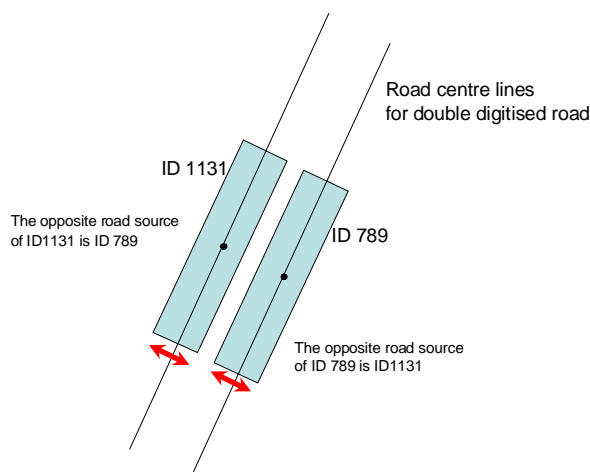


Figure 2.3. A double digitized road.

The user must supply the "road width" of each road segment (this parameter is an attribute in the shapefile). For a single digitized road this corresponds to the red arrow in Figure 2.2. For a double digitized road a "road width" should be supplied for each of the two (approximately) parallel road segments (Figure 2.3). Internally, the program calculates a total width as the sum of these two widths plus the centre strip.

2.4 Traffic parameters and temporal variation of emission

For target roads in OML-Highway the user must provide rather detailed information on traffic characteristics and the temporal variation of traffic. The user can benefit from various predefined files with traffic characteristics. For background roads the treatment is less elaborate. This section explains the procedure for target roads.

Traffic on each target road segment is classified into a “Traffic Composition Category”, according to (1) heavy duty share of traffic (HD share), (2) travel

speed, and (3) “OSPM traffic type” (A, B,...,H). The “OSPM traffic type” refers to a pattern of diurnal traffic variation on a road. By default eight OSPM traffic types are defined; for instance, there is a type representing “Transit roads in medium or smaller size cities”. Each road type is associated with a file that describes the diurnal pattern of traffic variation throughout a year (taking account of day of week and some seasonal variation).

The classification of road segments into Traffic Composition Categories takes place during data preparation with SELMA^{GIS}. The basis is the information provided in a road network shapefile provided by the user (Appendix, section 7.3.1) and a definition of classes, which is prescribed in the main SELMA^{GIS} configuration file, SelmaGIS.ini (more information in the Appendix section 7.4). If you wish to change the definition of classes you must edit SelmaGIS.ini directly – there is no way to do it through the menus.

Table 2.1 shows a listing of all Traffic Composition Categories present in the sample data set distributed with an OML-Highway installation. Such a listing can be found in an Excel file produced with SELMA^{GIS} during data preparation.

Table 2.1. Sample of file with Traffic Composition Categories. In this case only 8 different categories are represented, but the number could be different. The first column contains an ID for each category. The next three parameters taken together define a category, while NrOfSections indicates how many road segments pertain to each category in the data set considered.

ID	TrafType	HDshare (%)	Speed (km/h)	NrOfSections
1	Type_F.trf	10	70	93
2	Type_B.trf	15	120	37
3	Type_A.trf	15	120	20
4	Type_F.trf	15	120	11
5	Type_D.trf	5	50	14
6	Type_C.trf	0	30	1
7	Type_D.trf	10	70	2
8	Type_F.trf	5	50	1

2.4.1 Patterns of Diurnal Traffic Variation

As mentioned above, patterns of diurnal traffic variation are defined in a set of files. These are the so-called *.trf-files, or “Diurnal Traffic Variation files”. This is similar to how temporal variation of traffic is described in the Operational Street Pollution Model (OSPM). For Danish conditions eight different street types have been identified based on a comprehensive analysis of measured traffic data from different types of streets in different regions of Denmark with a focus on urban roads, but also applicable for other types of roads. For each of these types there is a *.trf file. A road segment can be associated with a certain “OSPM traffic type” – meaning that the pattern of diurnal traffic variation is defined by the corresponding *.trf file. A *.trf file describes diurnal, weekly and seasonal time variation of the fraction of each of five vehicle types (passenger cars, buses etc.).

Table 2.2 gives an overview of the eight OSPM traffic types used in Denmark; the corresponding *.trf files are supplied with the standard installation. *.trf files contain normalized data. In order to use the information for a specific road in OML-Highway it is necessary also to supply the annual average daily traffic (AADT) for the road, the share of heavy duty vehicles, as

well as an average travel speed for the road. This is done through the use of the above mentioned Traffic Composition Categories.

Table 2.2. Main characteristics of the 8 “OSPM traffic types” used in Denmark. A road can be assigned an “OSPM traffic type”. This implies that the traffic composition varies with time in a manner described in detail in the corresponding .trf file. In OML-Highway the distribution between vehicle types is not used directly, but scaled with the user provided share of heavy duty vehicles. Users outside of Denmark may create *.trf files reflecting the diurnal variation of local traffic.

OSPM traffic type	Description	Passenger cars (%)	Vans (%)	Trucks (<= 32 t) (%)	Trucks (> 32 t) (%)	Buses (%)
A	Transit roads in medium size or smaller cities	80.1	12.0	4.7	1.1	2.1
B	Transit roads in larger cities	81.9	10.8	2.8	1.4	3.1
C	Distribution roads in residential areas	83.2	12.1	2.5	0.74	1.6
D	Roads with a mix of residential and business area	81.9	11.7	3.0	1.5	2.0
E	Main street in center of larger cities	82.7	10.3	2.2	1.4	3.4
F	Access roads to larger cities	79.7	11.9	4.3	2.5	1.6
G	Road in larger and medium size cities outside center	82.9	12.6	2.6	0.7	1.2
H	Main street in centre of medium size city	83.2	12.4	2.3	0.7	1.4

Some technicalities on the use of *.trf files deserve further explanation. As a reader you may skip the following technical explanation and return to it later when you feel a need for it.

The structure of *.trf files is designed for use in WinOSPM. In OML-Highway the information in the *.trf file on vehicle composition is not used directly. This is because OML-Highway makes use of “binning” – classification of road segments into a limited number of “Traffic Composition Categories” – instead of applying the full flexibility of WinOSPM. This solution has been chosen because full flexibility would introduce a very heavy computational load.

Thus, when applying OML-Highway some of the information in the *.trf files is overruled by information provided by the user, and by the constraints imposed in the process of binning. In a shapefile for a target road the user must specify the parameters AADT (Annual Average Daily Traffic), the fraction in percent of heavy duty vehicles (trucks + buses) and the speed of light vehicles. These numbers overrule the information in the *.trf file, wherever there are conflicts. A user does not see this – it happens internally during the data preparation with SELMA^{GIS}.

An example may serve to clarify what goes on internally in that process.

Let us consider OSPM traffic type A in Table 2.2, where the share of light vehicles amounts to 92.1% (passenger cars + vans), and the share of heavy duty vehicles to 7.9% (two truck types plus buses). However, a user may specify in the shapefile that the heavy duty fraction for a certain road segment is, e.g., 9.1% and that the road segment should be assigned OSPM traffic type A. With default settings of OML-Highway, this implies that the road segment is ascribed a heavy duty fraction of 10%, because binning takes place, and the bins closest to 9.1% have heavy duty fractions of, respectively,

8 and 10%. The information in the *.trf file Type_A.trf is processed to reflect this. Thus, instead of literally using the heavy duty share of 7.9%, the rounded user-defined share of 10% is used. Next, the 10% heavy duty traffic is assumed to be distributed among vehicle types Truck 1 (≤ 32 t), Truck 2 (> 32 t) and buses in the same proportion as in the original file Type_A.trf.

If the user wants to use a different vehicle composition for, e.g., passenger cars and vans than that specified in the 8 standard OSPM traffic types, the user will have to modify the *.trf file with WinOSPM tools (*TrafEdit*).

2.4.2 Target roads: Summary of emission data preparation

The entire procedure in OML-Highway for establishing emission data for target roads with a temporal variation can be outlined as follows:

- The user provides information on each road segment in a road network ESRI shapefile.
- In SELMA^{GIS} input data for OML-Highway is generated, involving the following data processing:
 - Road segments are classified into bins, so each road segment belongs to a Traffic Composition Category
 - Traffic Composition Categories are coupled with information in *.trf files on diurnal variation of traffic and on emission factors. As a result, a lookup table is produced in the form of a so-called *.det file (“Diurnal Emission Variation for Target roads”).
Such a *.det file allows you to look up the annual emission for traffic of 10,000 vehicles (in $\mu\text{g}/\text{m}/\text{s}$) if you know three parameters: Traffic Composition Category, hour of day, and day case. “Day case” can for instance be *Sundays in July*. Eight day cases are defined, and the definition of day cases is given in the Appendix, Section 7.6.
- During further data processing in OML-Highway, the information in the *.det lookup table is linked to data on individual target road segments, thus allowing calculation of emission for each road segment.

There are further details on formats etc. in the OSPM user’s guide (Berkowicz et al., 2003) and in the Appendix (chapter 7). When working with *.trf files it is convenient to use the OSPM tool *TrafEdit*.

For background roads the procedure is simpler; see section 2.6.

2.5 Emission factors

The scheme for determining emission factors in OML-Highway follows that of WinOSPM. It is quite complex, and for a detailed explanation you are referred to the OSPM User’s Guide (Berkowicz et al., 2003). Here only a very brief introduction is given.

When generating input data for OML-Highway (Section 5.4) you will be asked for an OSPM *Vehicle List file* (*.vlf) and an OSPM *fuel list file* (*.flf). These files are used for calculation of emission factors.

A *Vehicle List File* basically contains pointers to other files, which contain the actual data used for calculations of emission factors.

A *Fuel List File* contains similar pointers as well as expressions for a fuel composition correction used for calculation of the emission factors.

Thus, in order to calculate emission factors numerous additional files are used, which the above mentioned files refer to. Working samples of such files are supplied with a standard installation.

Emissions are based on the COPERT IV methodology reflecting vehicle classes, engine size and weight classes, fuel types, emission dependence on travel speed and other parameters. In principle a user may manually modify the vehicle, fuel and emission files to reflect local conditions, but this is a very complex procedure and requires an in-depth understanding of the file structure.

2.6 Emission calculations for background roads

The treatment of background roads in OML-Highway is less elaborate than the treatment of target roads. The user has to provide information on the share of various vehicle types (passenger cars, vans, trucks and buses) on each road segment via attributes in the road network shape file. Later in the data processing the emission from background roads is averaged to yield a field of emissions for a grid of cells, where each cell has a typical size of 1 km by 1 km.

The user must assign a “Road type” to each road segment, where five different classes are possible. The classes and their code number are shown in Table 2.3. When using Selma^{GIS} to generate emission data for OML-Highway, averaging within each cell is undertaken for each road type separately. E.g., within each cell an average speed is calculated for roads of type 2111, another average speed for roads of type 2112 etc.

For background roads only one profile for the diurnal variation of emission is used, while for target roads there is a profile for each Traffic Composition Category. The profile for background roads is embedded in a so-called *.deb file (see section 5.5.3 and a description of the file in the Appendix, section 7.3.5).

It is mandatory to use the code numbers indicated in Table 2.3 that originates from a Danish classification of roads in the TOP10DK road network.

The background for classification into road types is discussed in a report by Jensen et al. (2008).

As implemented in OML-Highway this classification has consequences only for the subdivision of heavy duty traffic into three subtypes of heavy duty traffic (trucks lighter than 32 t, trucks heavier than 32 t and buses) and for the cold start share. Other required information is provided explicitly by the user in a road network shapefile.

In OML-Highway the classification is implemented through the SELMA^{GIS} configuration file. In the Appendix section 7.4 it is specified what the default classification implies and how it can be changed.

Table 2.3. The five possible road types for background roads.

Road type	Code for road type
Motorway (in Danish "motorvej")	2111
Express road/main roads (in Danish "motortrafikvej")	2112
Road > 6 m	2115
Road 3-6 m	2122
Other road	2123

3 Installation and setup in ArcMap

3.1 Overview of installation process

OML-Highway works in a GIS environment. This environment is based on the software ArcMap™, which is the main component of the ArcGIS™ suite of geospatial processing programs marketed by ESRI. Furthermore, OML-Highway requires the SELMA^{GIS} package supplied by Lohmeyer GmbH & Co. KG, Germany. In addition, the creation and handling of emission files as described here requires modules from the WinOSPM model. All of the mentioned software is Windows-based.

Altogether, the installation described here involves installation of the following software products:

- ArcMap (not supplied)
- SELMA^{GIS} with the OML-Highway component. A *License manager* is supplied with SELMA^{GIS}
- WinOSPM® in a limited or full version. OML-Highway is accompanied by a limited version (or, optionally, a full version) of WinOSPM®. The limited version gives access to various utilities for data preparation, as emission calculation and traffic editor, but not to run WinOSPM.

Additional recommended software is

- Microsoft Excel or other software capable of reading and handling Excel files.
- A text editor, e.g. TextPad.

Administrative privileges are required for installation of the software.

It is highly recommended that you set Windows to show the extension of file names. A default installation of Windows has turned on the option “Hide extension for known file types”, but the resulting behaviour of Windows is likely to confuse users when working with systems such as OML-Highway. You can find out how to change the setting by searching in Windows for “hide extension”.

Further, it is **required that you set the decimal separator to “.”** (period) **and the digit grouping symbol to “ ”** (space) in your Windows system.

3.2 Details of the installation procedure

We assume that you have already installed ArcMap, and that you have observed the instructions above on administrative privileges, filename extensions and decimal separator. Next, the following three steps should be taken. They are elaborated below.

- Install SELMA^{GIS} with the OML-Highway component.
- Copy the set of sample files accompanying the OML-Highway installation to a convenient location.
- Install WinOSPM®.

The order of these steps is not important.

3.2.1 Installing SELMA^{GIS}

SELMA^{GIS} may be accompanied by a Readme file, which should be considered. Normally, SELMA^{GIS} will be delivered with a dongle (USB key), which is necessary for the program to run (for licensing reasons).

- Be sure that ArcMap is not running and you have administrator rights on the operating system.
- Install the Rainbow Software from the SELMA^{GIS} CD (Rainbow\Sentinel Protection Installer 7.6.5.exe or download current version from <http://www.safenet-inc.com/support-downloads/-sentinel-drivers/> for your operating system.
- Put the dongle in an USB Port.
- Execute the setup.exe from the SELMA^{GIS} installation CD (or installation package) and follow the instructions. You will encounter a license agreement partly in German. Scroll down to see the English text and accept the terms.
- You will be asked for a Destination Folder for the installation, and a suggestion of C:\Lohmeyer\SELMAGIS. We suggest to change the destination folder to C:\Apps\SELMAGIS
- After installation, open the SELMA^{GIS} licence manager (just labelled "Licencemanager") under the Taskbar from Windows and check if the SELMA^{GIS} Basic Module and OML-Highway are available. Otherwise you must use the Register button.

When opening ArcMap a SELMA^{GIS} toolbar should be visible (shown in Figure 5.1). If it is not visible, you should select the menu Customize > Extensions and check that SELMA^{GIS} is available. Next, right-click in the toolbar area and ensure that the SELMA^{GIS} toolbar is selected.

Folder with sample files

The OML-Highway software is accompanied by a set of sample files. You may receive the folder with sample files separately, not being part of the installation. In that case you should put it in a folder of your choice, which we will here refer to as the folder *TestData*. This data set is a sample of the data necessary to get a project started. It is described in the appendix, section 7.5.

3.2.2 Installing WinOSPM

Below is an outline of the installation process for WinOSPM. You may find updated or more detailed information in a Readme file.

- Unzip the installation files into a temporary folder on your local hard disk.
- Start the installation by running '*Setup_4_All_Users.bat*' in the installation package to allow all users on the PC to run the WinOSPM (if you just run "*Setup.exe*" the software can only be used by the current user).
- Accept the suggested installation path '*C:\Apps\WinOSPM*'.
- The first time you start WinOSPM you will be asked for Country settings. Choose '*Denmark*' and press OK. Adding a new country is a tricky procedure and should not be done until later when you have gained some experience with WinOSPM.
- If you have previously entered a valid license key on this PC, this key will remain valid; otherwise you have to enter your license key.
- WinOSPM is using a version of Windows Help, which is not installed from the beginning on newer Windows systems. However it can be installed manually. The first time you try to use Help in WinOSPM (e.g. by pressing the key '*F1*') you will be guided and can download and install the missing components (*WinHlp32.exe*).

Note that the OSPM User's guide is available via the menu *Help* in WinOSPM.

4 Getting started

4.1 Guide for the first-time user

If you are a first-time user of OML-Highway it is recommended to start reading a few sections in this manual, and subsequently to try to work with a sample data set.

It is recommended that you skim through Chapter 2 on basic concepts, and as a minimum get acquainted with the concepts of Target roads and Background roads. You can later return to the description of concepts.

Install the software if you do not already have a working installation (Chapter 3).

Then read the first sections of Chapter 5 on basics, on the SELMA^{GIS} menu, and the introduction to the OML-Highway Navigator. This will instruct you how to get started with a sample data set.

Subsequently go on to work your way through the various menus, guided by the descriptions of the various menu items in Chapter 5.

Note that the Appendix (Chapter 7) contains a lot of reference material, including descriptions of the numerous file types involved in an OML-Highway project.

4.2 Sample files

The software is accompanied by a set of sample files, located in the folder TestData. This data set is a sample of the data necessary to get a project started (RoadNetwork shapefile and a few OML-Highway text files as Background, Meteorology, deb file). You find a few more details on the sample data set in the Appendix, section 7.5.

We make use of this sample data set in the next chapter: *Working through the menus*.

5 Working through the menus

5.1 Basics

As a user of OML-Highway you will encounter two types of project files: ArcMap project files with extension *.mxd and SELMA^{GIS} project files with extension *.sel. An ArcMap project file defines maps, layers etc., while a SELMA^{GIS} project file defines the setup of an OML-Highway run.

Start by opening ArcMap. When entering ArcMap you should see the SELMA^{GIS} toolbar displayed as in Figure 5.1. If you don't, then check the chapter on installation.

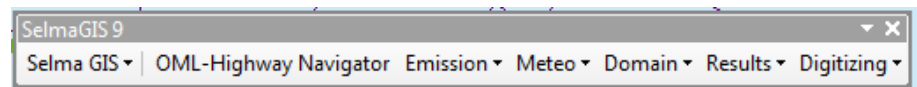


Figure 5.1. SELMA^{GIS} toolbar. The toolbar can be floating or docked. If docked, the left edge is a handle that can be used to move the toolbar.

Most of the items on the SELMA^{GIS} toolbar are drop-down menus. The one exception is "OML-Highway Navigator", which is a button to start a wizard.

In the subsequent descriptions we will often refer to a package with sample datasets: TestData. This package contains a sample of the data required to build a project.

You can get familiar with the working environment of OML-Highway by placing a copy of TestData in a convenient location and then start building a SELMA^{GIS} project.

In the following we will describe how to create a Selma^{GIS} project called MyTest. We start by copying the files and folders in TestData to a folder structure under the name *MyTest*.

Start ArcMap and open the ArcMap project

MyTest\RoadNetwork\RoadNetWork_And_TargetRoads.mxd

Two layers should be present: TargetRoadsOnly and RoadNetwork.

If the checkmarks are light grey with a red '!' mark as in Figure 5.2 click on one of the layer names twice. This allows you to set the correct data source by selecting the Source tab and browse to the location of the relevant shapefile which has been copied from the TestData package

(e.g. RoadNetwork\TargetRoadsOnly.shp) and choose it as data source. Repeat this for the second layer. You may have to zoom to the layer afterwards in order to see a map.

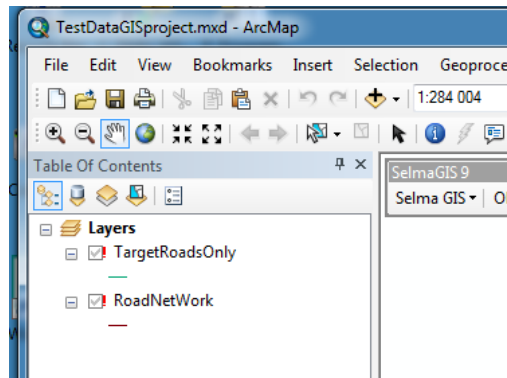


Figure 5.2. Opening the sample ArcMap project for the first time.

Save the ArcMap project (RoadNetWork_And_TargetRoads.mxd).

Subsequently use the SELMA^{GIS} dropdown menu on the SELMA^{GIS} toolbar to create and save a new SELMA^{GIS} project with the name MyTest.sel in the MyTest folder. For the subsequent illustrations we use this project, and we place all its files within the MyTest folder.

In the subsequent sections of this chapter (5.2 to 5.11) we will present the features that can be accessed from the SELMA^{GIS} toolbar.

5.2 SELMA^{GIS} menu

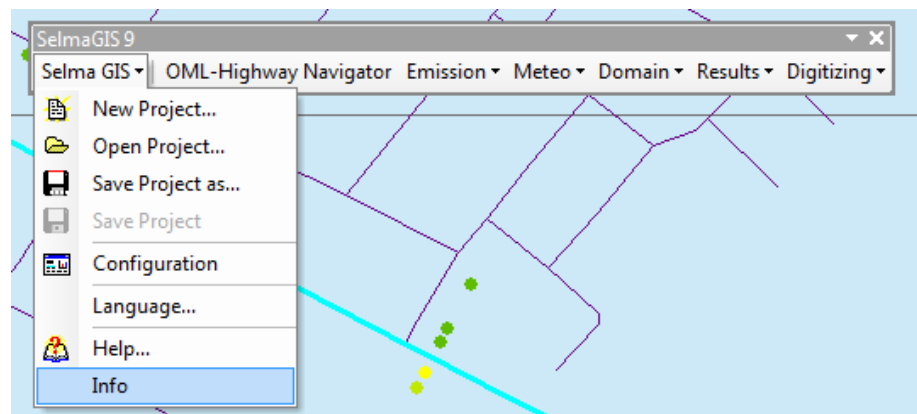


Figure 5.3. The SELMA^{GIS} drop-down menu sits at the left side of the SELMA^{GIS} toolbar.

The leftmost item on the SELMA^{GIS} toolbar is the SELMA^{GIS} menu. It allows you to create a new project, open an existing, etc.

If you create a new project, you will be taken immediately to the OML-Highway Navigator, which is a wizard to lead you through the setup of an OML-Highway run. The OML-Highway Navigator is described in detail in several subsequent sections.

From the SELMA^{GIS} menu you can access a comprehensive help file. This describes use of the SELMA^{GIS} framework. Currently (June 2014) the help file does not describe the OML-Highway Navigator, but this may change with later software versions. Check this by opening SELMA^{GIS} help.

The item Info (bottom of menu) will compile a detailed inventory of version dates of various components of the SELMA^{GIS} and OML-Highway software. This is useful in case you request support.

The item Configuration is only of interest if you work with other tools in SELMA^{GIS} than OML-Highway, such as AUSTAL2000 or PROKAS.

5.3 OML-Highway Navigator - introduction

OML-Highway Navigator is a wizard to lead you through the setup of an OML-Highway run. You can start the Navigator by pressing the button "OML-Highway Navigator" on the SELMA^{GIS} toolbar.

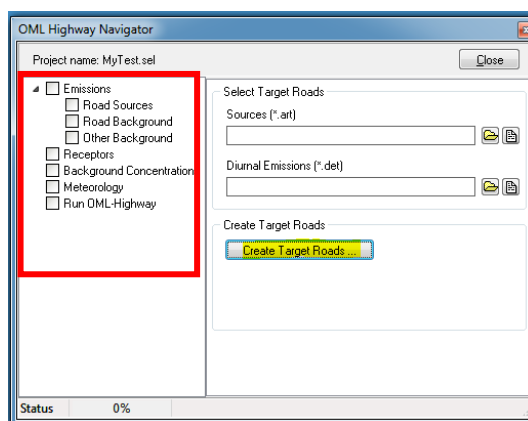


Figure 5.4. Appearance of OML-Highway Navigator for a new, empty project. The various check boxes on the left will be filled as the project is defined. Use the labels within the red box in order to navigate through tasks. Press the highlighted button "Create Target Roads" to get started with the first task.

The mode of operation of OML-Highway Navigator requires a bit of explanation.

The user can perform various tasks related to data preparation by clicking the labels "Road Sources" etc. in the left panel. These labels are used for navigating between the tasks. A click on a label changes the content of the panel on the right. Next to each label is a box meant to display a tick mark when the task is finished – you cannot place a tick mark by clicking in the box.








At many stages in the process, the right-hand panel will allow you to fill in certain file names. Typically, these requested files do not exist at first, and therefore you cannot initially fill in the boxes meant for file names.

However, the right panel contains a button – like the button "Create Target Roads" in Figure 5.4. This button is the key to performing the current task, unless you are already in possession of the files requested. Not all panels have such a button, but if there is one, you should press it. This will lead you deeper into the process of generating the appropriate files.

5.3.1 Buttons

You will encounter various buttons in the menus of OML-Highway Navigator. They are briefly explained in Table 5.1.

Table 5.1. Buttons in OML-Highway Navigator

	Allows you to browse for a file or a path.
	Allows you to specify path and name of a file that will be created. It is mandatory to use this button to name the file – it won't work just to type a file name.
	Allows you to inspect a file with a suitable piece of software (the software associated with the file extension).
	For meteorological data: Displays data as a wind rose.
	Opens OSPM Traffic Editor. Allows you to inspect and work with traffic data based on files of type *.trf, *.vlf, *.flf and several others.
	Opens OSPM EmiFact. Allows you to inspect and work with emission factors.
	For shapefiles. Adds a layer in ArcMap

5.4 Emissions - Road Sources

OML-Highway Navigator can assist in the task of preparing files, which can be used as input to OML-Highway. The first task in the Navigator concerns *emissions from target road sources*. This is a process involving three steps. The files that are created have extension *.art ("ARea Target")¹ and *.det ("Diurnal Emission variation for Target roads").

In the left-hand panel select the label "Road sources" and then in the right-hand panel click the button "Create Target Roads".

This opens the window "Road Source Characteristics - Step 1" (Figure 5.5) which is discussed next.

5.4.1 Road source characteristics - Step 1

In this step an *.art file and certain other files are created by filling in the fields shown in Figure 5.5.

¹ The term "area" is referred to in the description of the extension, because this file describes area sources, as opposed to point sources.

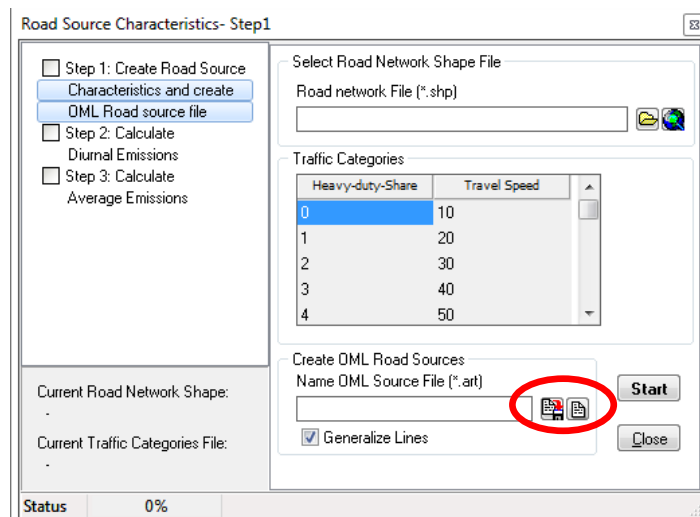


Figure 5.5. Road Source Characteristics, Step 1 where an *.art file is created. You must select an existing Road network shapefile (right panel, top) and indicate the name and location of an *.art file to be created (right panel, bottom). The reddish icon inside the red ring allows you to browse to a suitable location for the *.art file, while the other icon allows you to inspect the contents of the file when it has been created.

The *Close* button will bring you back to the OML-Highway Navigator window. When you're done with Step 1 you don't have to use *Close*, but can simply progress by clicking on the label *Step 2*.

The caption of Figure 5.5 explains the essentials about filling in the two required fields. Some more details follow here.

It is required that you have a Road Network shapefile which corresponds to the specifications given in Table 7.2. It should represent target roads, but may include background roads as well. There is a sample of such a file in the sample package, located at
 TestData\RoadNetwork\RoadNetWork.shp

This sample file represents both target roads and background roads; for each record the parameter Tflag indicates whether it is a target road (1) or a background road (2).

The grey table labelled "Traffic categories" in Figure 5.5 is displayed for information only – nothing in the grey table can be changed from the current panel. It should be understood that the two columns in the panel are independent of each other.

The table is related to the fact that traffic on each road segment is classified into a “traffic composition category”. The classification takes place according to (1) heavy duty share, (2) travel speed, and (3) “OSPM traffic type” (A, B,...,H). The grey table shows possible classes for heavy duty share and travel speed. You can consult section 2.4 (Traffic parameters and temporal variation of emission) for further details.

When you are done filling in the fields, press the *Start* button.

After a successful run you are informed that an “RSC” shapefile, a Traffic Category file, and an OML Road source file have been created. You should allow the RSC file to be added to ArcMap. The RSC shapefile ("Road Source Characteristics" file) has a name similar to MyTestRSC.shp; the contents of the file are illustrated in Figure 5.6.

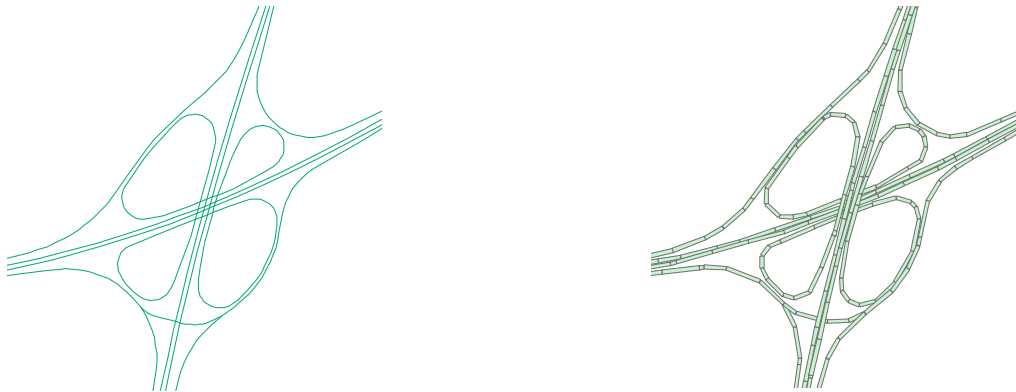


Figure 5.6. Example of target roads as specified in the Road Source Network file (left) and as specified in the Road Source Characteristics (RSC) file (right). In the first file roads are lines, while in the latter they are represented as small segments with a finite width (area sources).

The Traffic Category file is a small Excel file with information on the number of road sections pertaining to each category, which is characterised by speed, heavy duty share and Traffic type.

The OML Road source file is an *.art file, e.g. MyTest.art. This is a text file used by OML-Highway to provide information on all target road segments and the traffic they carry. It can be inspected by pressing an icon seen in Figure 5.5 (the right button within the red ring).

5.4.2 Road source characteristics - Step 2

In this step a *.det file ("Diurnal Emission variation for Target roads") is created by filling in the fields shown in Figure 5.7.

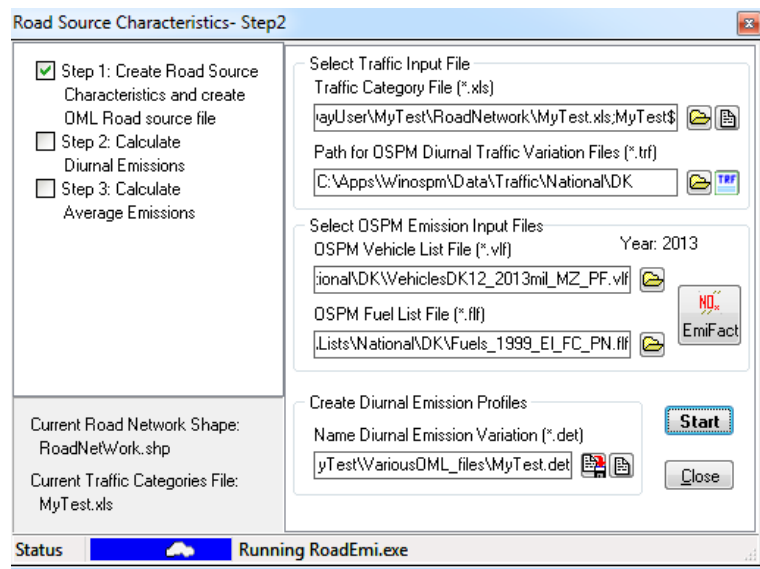


Figure 5.7. Road Source Characteristics, Step 2 where a *.det file is created. When you encounter this window, the uppermost file name (the *.xls Traffic Category file) will typically be filled in, because it was created during Step 1. The subsequent fields must be filled in as explained below.

To the right of each field are two icons: the leftmost is for browsing to the file, while the rightmost is for inspecting the file with suitable software.

It is required that you have access to certain files which are typically created with OSPM tools. With a default installation you can find samples as indicated in the following. Three categories of files are required:

- OSPM Diurnal Traffic Variation Files (*.trf); you must indicate a folder, where several such files are present. There is one such file for each "OSPM traffic type" (see Section 2.4). With a default installation you may indicate the path C:\Apps\Winospm\Data\Traffic\National\DK
- An OSPM Vehicle List file (*.vlf). With a default installation you may as an example indicate the file C:\Apps\Winospm\Lists\National\DK\VehiclesDK12_2013mil.vlf
- An OSPM Fuel List file (*.flf). With a default installation you may as an example indicate the file C:\Apps\Winospm\Lists\National\DK\Fuels_1999_EI_FC_PN.flf

There are more details on the contents of these files in the OSPM manual.

The outcome of Step 2 is a *.det file ("Diurnal Emission variation for Target roads"). You must specify a name for it in the last field of the window, e.g. MyTest.det. The *.det file is a text file used by OML-Highway to provide information on the time variation of emissions from target road sources. Emissions are normalised to an annual daily traffic of 10,000 vehicles. The *.det file can be inspected by pressing the rightmost icon besides the name of the file (see Figure 5.7). The file is further described in Chapter 7.

5.4.3 Road source characteristics - Step 3

In this step average emissions are calculated. The files required to undertake this task have been produced in the previous steps, so not much more is required than pressing the Start button in Figure 5.8.

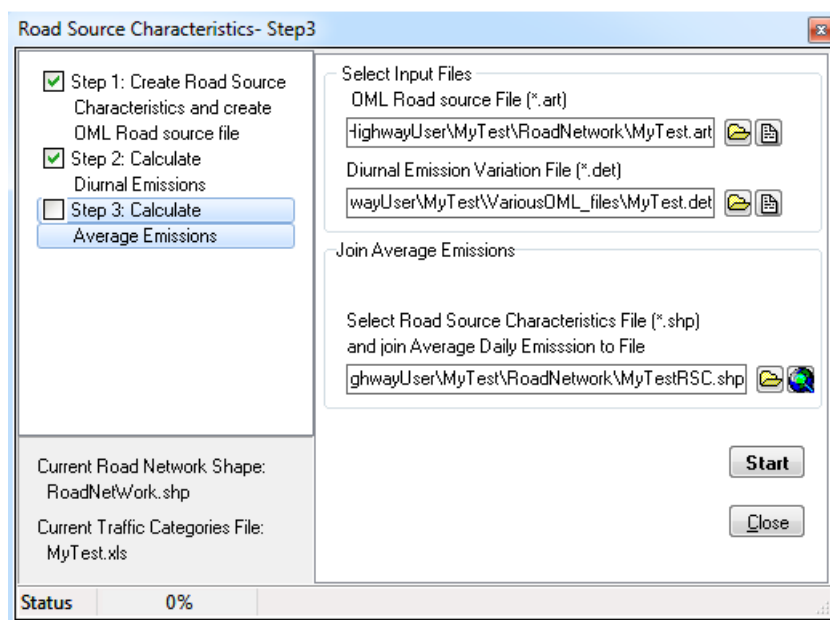


Figure 5.8. Road Source Characteristics, Step 3 where average emissions are calculated.

You will be notified that calculations were successful.

When you close the window you will be asked to confirm that you wish to add the *.art file and the *.det file to the current project. You should confirm this in order to have the result of your work reflected in the main window of OML-Highway Navigator as shown in Figure 5.9.

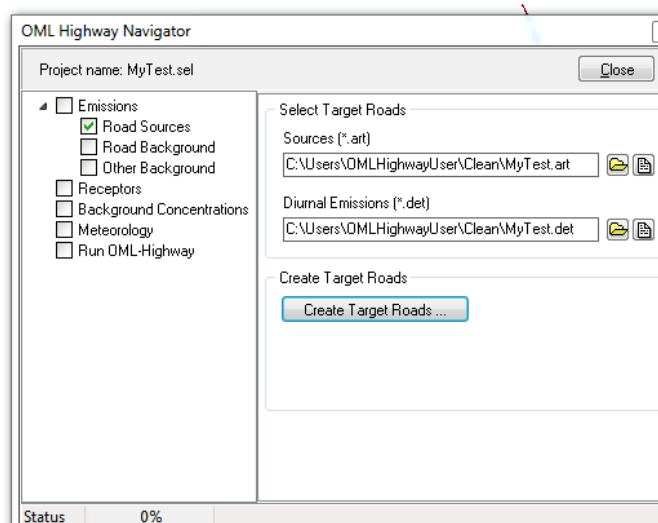


Figure 5.9. After finalising the three steps concerning Road Source Characteristics for target roads there is a checkmark next to "Road sources" in the main window of OML-Highway Navigator.

5.5 Emissions - Road Background

OML-Highway Navigator offers to assist with preparation of a file concerning *emissions from background roads*. This is a process involving two steps. The file which is created has extension *.arb ("ARea Background").

Files of type *.arb (for background roads) differ substantially from *.art files (for target roads). A file of type *.arb describes cells with gridded emission data covering the entire area with background roads, whereas a file of type *.art describes physical characteristics of target road segments and the traffic amount on segments, but not emissions.

In the left-hand panel in OML-Highway Navigator select the label "Road Background" and then in the right-hand panel click the button "Create Background Roads".

This opens the window "Background Grid Emissions - Step 1" (Figure 5.10) which is discussed next.

5.5.1 Background Grid Emissions - Step 1

In this step an MS Access database file (*.mdb) is created, referring to a grid of background emissions. The database is populated with the information on the kilometres travelled within every grid cell.

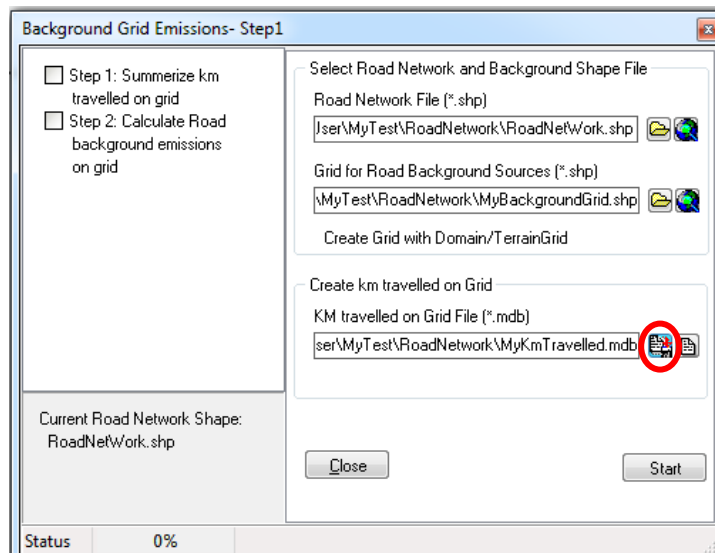


Figure 5.10. Background Grid Emissions, Step 1 where an *.mdb (database) file is created. Initially, all three fields in the right panel are empty. You must select (1) an existing Road network shapefile and (2) an existing shapefile defining a grid. Furthermore indicate the name and location of an *.mdb file to be created (right panel, bottom). It is mandatory to use the button marked with a red circle when you specify this file.

The caption of Figure 5.10 explains the essentials about filling in the two required fields. A few more details follow here.

It is required that you have a Road Network shapefile which corresponds to the specifications given in Table 7.2. It should represent background roads, but may include target roads as well. There is a sample of such a file in the sample package located at TestData\RoadNetwork\RoadNetWork.shp (this is the same sample file which was used to represent target roads in Section 5.4). This sample file represents both target roads and background roads; for each record the parameter Tflag indicates whether it is one or the other.

Furthermore, before you can fill in the field "Grid for background road sources" it is required that you have such a file. SELMA^{GIS} gives you tools to generate this file as explained in the following subsection, *Generating a grid for background road sources*. You may close the current window in OML-Highway Navigator and return later.

The third and final field in the window shown in Figure 5.10 is for specifying the name of the *.mdb file, which is about to be created. You must use the button inside the marked red circle for that purpose. Otherwise, you will get error messages ("The intersection could not be done") when you press Start.

When all file names are filled in as illustrated in Figure 5.10 you can press the button *Start*. You receive a message when the calculations are finished. Confirm that you wish to add the file to Step 2. ("Adding" a file to a project implies that the file name appears in OML Highway Navigator; if you have previously added the same file, nothing is changed by "adding" it once more).

5.5.2 Generating a grid for background road sources

When filling in the menu *Background Grid Emissions - Step 1* you are required to have a shapefile with a grid for background road sources. You can generate such a file by using the SELMA^{GIS} tool bar. Choose *Domain > Terrain Create*, and you will be presented with the dialog box shown in Figure 5.11.

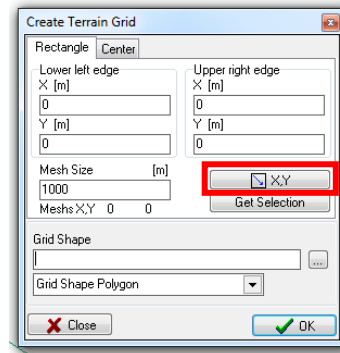


Figure 5.11. Dialog box for creating terrain grid. Mesh size is filled in with 1000 m.

It is possible to define a grid shapefile by selecting a rectangle on the map displayed in ArcMap or by defining the centre of the grid and give the height and width extent. In any case the mesh size has to be defined. Here, we outline the approach with creation of a grid rectangle. Further explanation can be found in the SELMA^{GIS} help text, topic *Terrain Grid*. The help text can be accessed through the SELMA^{GIS}-dropdown menu on the SELMA^{GIS} toolbar.

In the dialog specify a Mesh size (e.g. 1,000 m). Press the X,Y button (marked with a red rectangle in Figure 5.11). You should then see the tiny toolbar shown in Figure 5.12, which allows you to draw and move a grid.

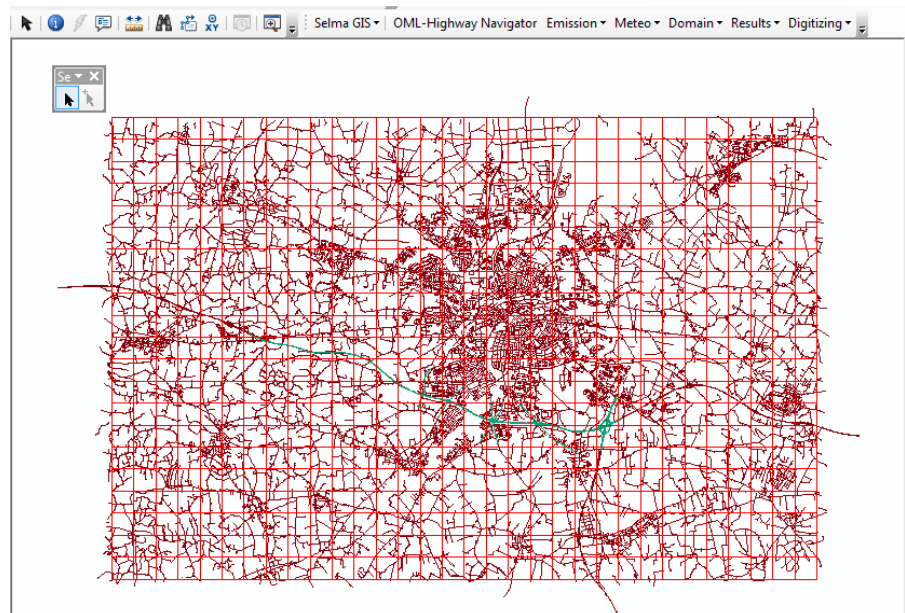


Figure 5.12. A click on the arrow icon on the tiny toolbar in the upper left corner (Selma Terrain Factory) allows you to draw a grid.

If you press the Shift key while you draw the grid it will snap to rounded coordinates corresponding to the mesh size. Finally, in the field *Grid Shape*

specify a file name, using the button to the right. Click OK in order to generate the grid file.

Note that with a standard installation a grid size of 1,000 m is required by default. It is possible to use another grid size, but in that case you need to change a setting in the configuration file Selmagis.ini – see the Appendix, section 7.4.

5.5.3 Background Grid Emissions - Step 2

In this step a file of the type *.arb ("ARea Background") is created.

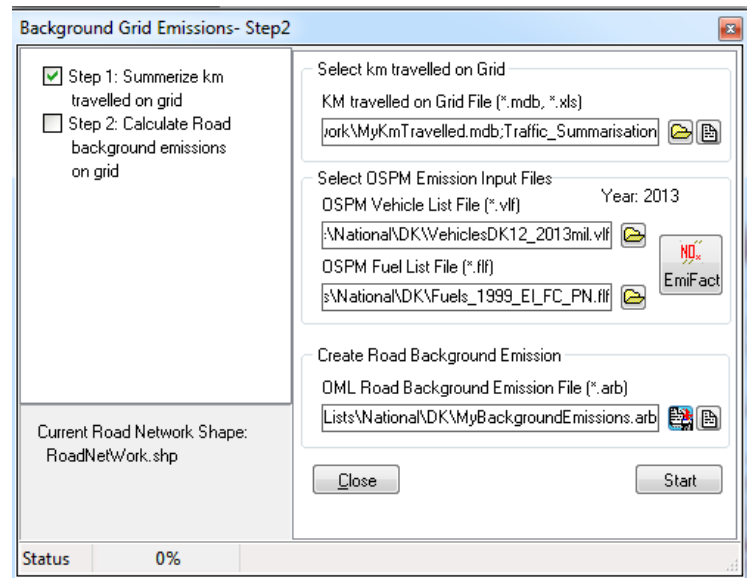


Figure 5.13. Background Grid Emissions, Step 2. When you encounter this window, the uppermost file name (the *.mdb Traffic Category file) will typically be filled in because it was created during Step 1. The subsequent fields must be filled in as explained below. To the right of each field are two icons: the leftmost is for browsing to the file, while the rightmost is for inspecting the file with suitable software.

Similar to the procedure for target roads it is required that you have access to certain files which are typically created with OSPM tools. With a default installation you can find samples as indicated in the following. Two files are required:

- An OSPM Vehicle List file (*.vlf). With a default installation you may as an example indicate the file
C:\Apps\Winospm\Lists\National\DK\VehiclesDK12_2013mil.vlf
- An OSPM Fuel List file (*.flf). With a default installation you may as an example indicate the file
C:\Apps\Winospm\Lists\National\DK\Fuels_1999_EI_FC_PN.flf

There are more details on the contents of these files in the OSPM manual.

The outcome of Step 2 is an *.arb ("ARea Background") file. You must specify a name for it in the last field of the window in Figure 5.13. The *.arb file is a text file used by OML-Highway; it provides information on gridded emission from background roads.

Press the Start button, and after a successful run you can close the window and confirm that you wish to add the *.arb file to the current project.

In addition to the *.arb file, a *.deb ("Diurnal Emissions Background") file is required for OML-Highway to run. This is a file somewhat similar to the *.det file that contains information on the diurnal variation of emissions from the target roads, but the *.deb file concerns background roads and relative diurnal emission factors. The file contains diurnal emission profiles that are normalized to 1 for all pollutants. There is no tool in SELMA^{GIS} to produce this file. If data for the area of interest are available the user can create this file manually. Otherwise, the sample *.deb file provided with the installation package can be used if seen appropriate for the region. Typically, a precise description of the diurnal variation of emissions for background roads will be less important than the diurnal variation for target roads, and therefore use of the sample file will be acceptable.

The sample *.deb file is located as
VariousOML_files\BackgroundDiurnalEmissions.deb. The *.arb and *.deb files can be inspected by pressing the rightmost icon besides the name of the file (see Figure 5.14).

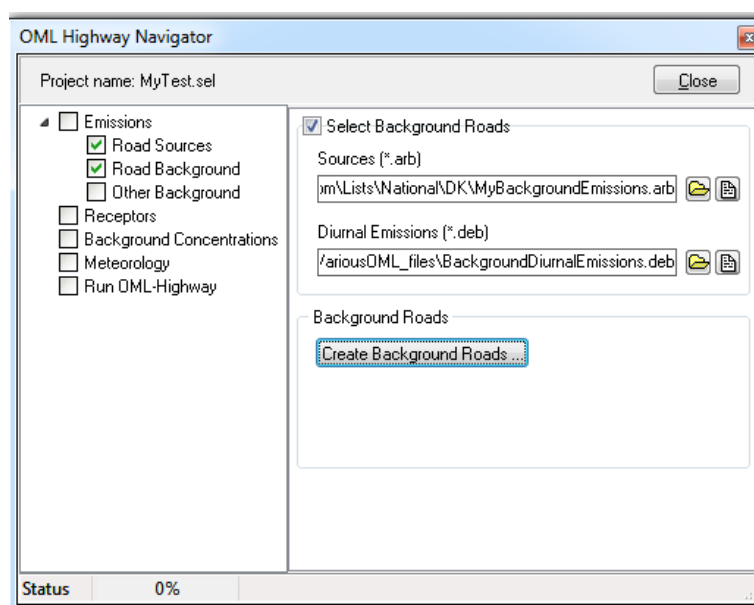


Figure 5.14. OML-Highway Navigator window after an *.arb file has been created and a *.deb file specified.

5.6 Emissions - Other Background Emissions

In the third and last dialog to create emission input files you can specify the data for other background emissions (an *.aro file) and create a shapefile from your *.aro file. If you don't have any important background sources other than traffic you can skip this step. However, you must make sure to remove the checkmark, which may be set at "Select Other Background Emissions" (if you don't, you won't be able to run the OML-Highway model in the last step).

There is an example of an *.aro file in the sample data set, as
VariousOML_files\OtherBackgroundSources.aro

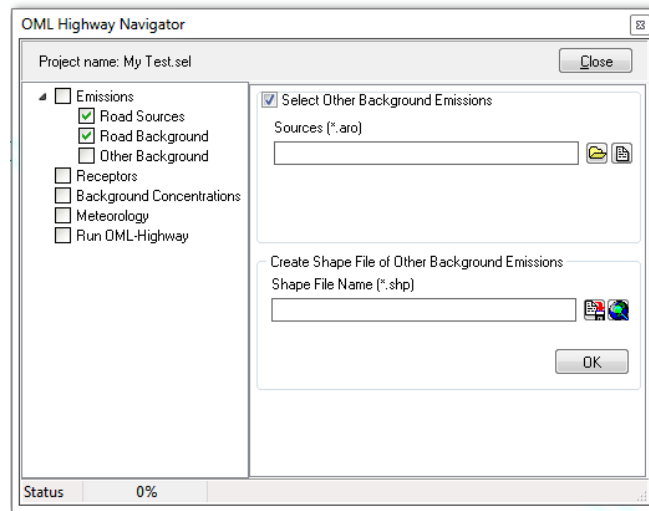


Figure 5.15. You can use this menu if you wish to take other background emissions than road sources into account. If you don't want this you should make sure to deselect the check mark on top ("Select Other Background Emissions").

5.7 Receptors

Concentrations are calculated in receptor points, the location of which can be specified by the model user. OML-Highway Navigator offers to assist with preparation of files concerning receptor points.

You can access these tools from OML-Highway Navigator by selecting the label *Receptors* and clicking the button *Create Receptor File*. As an alternative, you can use the SELMA^{GIS} toolbar and select *Domain > Receptors OML*.

This leads to the window shown in Figure 5.16.

Receptor Points

Along Roads | Background | Import OML | Points

Select Road Shape (*.shp)
 er\MyTest\RoadNetwork\TargetRoadsOnly.shp

ID	Distance [m]
1	20
2	40
3	70
4	100
5	150

Buttons: Add, Remove, Remove All, Save Points..., Load Points...

Perpendicular Distance [m]: 400
 Offset for Perpendicular Distances [m]: 0

Default Parameters
 Default Terrain Height [m]: 0
 Default Receptor Height [m]: 2

Create Receptor Shape File
☒ Create New Points ☐ Create Line
☐ Append Receptors
 badNetwork\ReceptorPointsInPerpendiculars.shp
 Create Receptorpoints

Global Parameters
 Largest Terrain Inclination [°]:
 Global Roughness Value [m]:

Create OML Receptor File (*.rct)
 Convert To *.rct

Close

Status: 0%

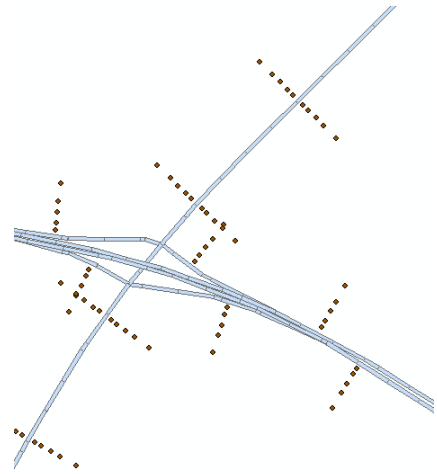


Figure 5.16. Tools for creating receptor points. The tab *Along roads* is selected and partly filled in. To the right the result is illustrated: Receptor points are distributed along target roads. They are situated in 'perpendiculars' (series perpendicular to the road) with a distance of 400 meters ("perpendicular distance") and extending to a distance of 150 meters from the road. The "Offset for perpendicular distances" can be set to 0, unless you wish to move the set of receptors a certain distance along the road.

There are four tabs, corresponding to four methods to create or import receptor points.

5.7.1 Receptors along roads

An often used tool allows the user to generate receptor points along target roads, at various distances from the road. Figure 5.16 shows the tab corresponding to this tool. The top part of the menu is filled in, allowing receptor points to be created.

First, a road shapefile is specified. Next, "perpendiculars" with series of receptor points are defined as illustrated in Figure 5.16.

The parameter of default terrain height is mandatory although it only matters if you are particularly concerned about high bridges (elevated points). In all other cases the emission will follow the local orography.

The "receptor height" is the height (above the ground) where concentrations are considered. Often a height of 1.5 m or 2 m is used.

The user must specify the name of a shapefile to contain the generated receptor points. This is done by pressing the button next to the file name field.

When all fields above the button *Create Receptorpoints* have been filled in, the button can be pressed and a shapefile thereby generated.

This shapefile is not sufficient as input to OML-Highway; OML-Highway needs a receptor file in *.rct format. For this purpose the bottom part of the menu in Figure 5.16 must be filled in. The largest terrain inclination in the area must be specified, as well as the general roughness length of the area. The roughness length depends on land cover. Often, a value of 0.1 m is used in the countryside and 0.3 m in urban areas. There is a drop-down menu to assist in the selection. Note that there is an option (-1) to indicate that you will just use the roughness length from the meteorological data file. In the help text of SELMA^{GIS} there is a table indicating examples of land cover and roughness values. The end results in terms of concentrations are normally not very sensitive to the values chosen for terrain inclination and roughness length.

For the advanced user it can be of interest to know that the drop-down list with roughness values is defined in the initialization file SelmaGIS.ini (more information in the Appendix section 7.4)

At the bottom of the menu the user must specify the name of an *.rct file (OML receptor file). This must be done making use of the button just to the right of field. When the name has been specified (and provided that a receptor shapefile has already been created), the button *Convert to *.rct* can be pressed.

The receptor point menu contains the option “Create line”. This is a facility which can be useful for presentation purposes. It is explained in more detail in section 5.7.5.

5.7.2 Receptors in a background source grid

The menu shown in Figure 5.16 has four tabs, corresponding to four methods to create or import receptor points. The second tab “Background” allows the user to create receptor points based on a background source grid (the creation of such a grid was discussed in Section 5.5). One receptor point will be created in the centre of each grid cell.

5.7.3 Import of existing OML receptor file

The third tab in the menu shown in Figure 5.16 can be used for the situation, where the user has an OML receptor file (*.rct), but not a corresponding shapefile, and wishes to create one. By default “Use parameters from input file” is checked, implying that values for receptor and terrain height are taken from the OML receptor file.

This import option is also useful if you have several *.rct files, which you wish to combine. You can then take a detour via shapefiles, which you create here, and subsequently import using the fourth tab (explained next).

5.7.4 Import of receptor point shapefile

The fourth tab in the menu shown in Figure 5.16 can be used to convert a receptor point shapefile to an OML receptor file (*.rct). If you have several shapefiles you can combine them by checking the option “Append Receptors” for the second and later files when you create a combined shapefile. Finally, you can convert this shapefile to an OML receptor file.

5.7.5 Creating buffer zones for presentation purposes

Above, basic information concerning creation of receptor points is given. By applying ArcMap tools there are various ways to present model results. The left part of Figure 5.17 shows how symbols in receptor points can be colour-coded to visualise concentrations. If you want a smoother visualization like the one on the right with buffer zones you can make use of the option “Create line” in the receptor point menu and subsequently apply various ArcMap tools. This involves an alternative way of creating receptor points. The procedure is explained in the following; it may appear complicated, so you may choose to read it only when you need it.

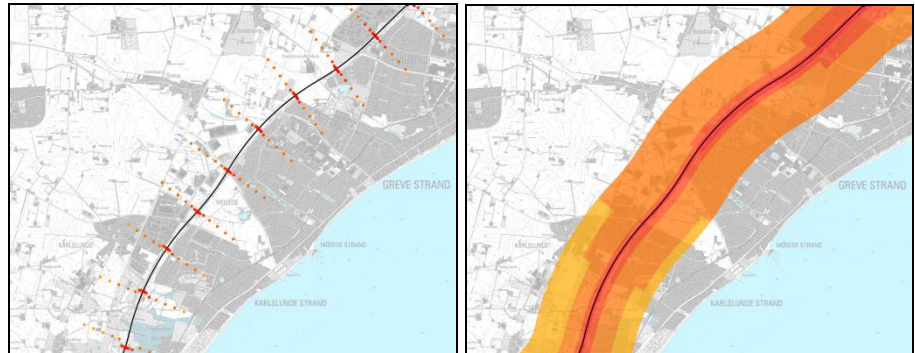


Figure 5.17. Visualisation of OML-Highway results (concentrations). On the left symbols in receptor points are colour-coded. On the right a procedure with creation of buffer zones has been used. Here, a receptor has been placed in the middle of each buffer zone (see text).

In Figure 5.18 (left) the menu for receptors along roads has been filled in with values of 20 m and 2,020 m for perpendiculars, and the “Create line” option has been checked. This implies that the button “Create Receptors” has been replaced by a button named “Create Lines”. The result of using it is shown on the right in the figure: Lines are drawn perpendicular to the road, between points 20 m and 2,020 m from the road on each side (due to the scale in the figure no gaps at the road are visible). The distance between the lines is 1000 m; an offset of 500 m has been specified, but this is unimportant – it just moves the entire set of lines 500 m along the road (compared to 0).

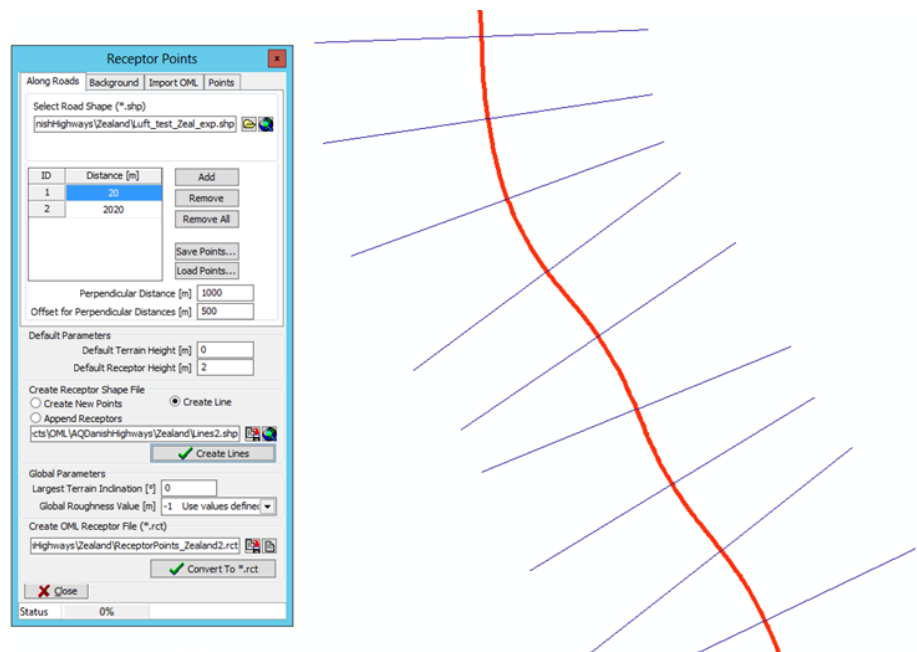


Figure 5.18. Using the menu for receptors to create lines perpendicular to target roads. These lines are used in a subsequent process, where polygons are created with ArcMap tools.

Next, you can use the ArcMap tool *Multiple Ring Buffer* tool located under Analysis Tools/Proximity to create buffers around the target roads. You can define the number of buffers at each side of the road located and the distance between them.

By using the *Split Polygons* tool located under the Topography tool and using the previously created lines, this buffer zone is then cut into n continuous polygons along the road network, where n denotes the number of receptor points on each side of the road. Next, by using the *Multipart to Singlepart* tool located under Data Management/Features the polygons can be further split into individual smaller polygons, each representing a polygon around each receptor that you wish to create on each side of the road network.

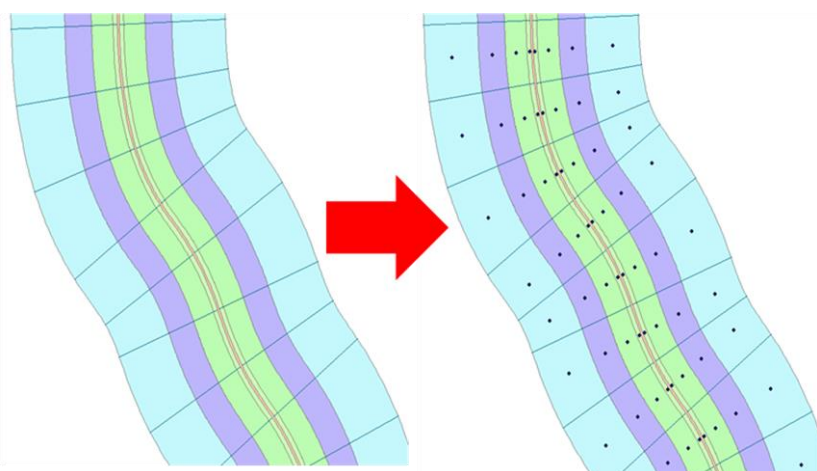


Figure 5.19. Buffers along target roads and receptor points placed within them.

Further, create a shapefile with receptor points in the centre of each polygon (using the tool Data Management > *Feature to point*) as illustrated in Figure 5.19. This shapefile is used as input to the fourth tab in the receptor point menu (section 5.7.4) to create an *.rct file for OML-Highway.

After running OML-Highway you can join a shapefile containing results to the receptor file with polygons, using proximity as a criterion for the join. With the resulting file you can visualize results to get an output similar to the right part of Figure 5.17.

5.8 Background concentrations

OML-Highway can make calculations of air pollution concentrations based on the emissions provided in the previous steps. However, there is additional air pollution that has to be taken into account, namely regional background concentrations. This concentration contribution is the result of emissions from other sources than those explicitly specified, typically from sources outside the domain considered.

Some air pollutants – such as CO – are simply additive, in the sense that total concentration can be found by adding background values and local concentration contributions. However, for others, in particular NO₂, NO and ozone, there is an interaction involving chemical reactions, so their level can only be correctly determined if background concentrations are taken into account.

Therefore, the user should by some means acquire hourly data for the background concentration of a number of air pollution components and provide them as input for OML-Highway. For instance, there may be available observational data available from a rural monitoring station or from a regional air quality model. The structure of the file with background concentration data (a *.dat file) is described in the appendix, section 7.3.6. The pollutants in the file are NO_x, NO₂, O₃, CO, CO₂, PM_{2.5}, PM₁₀ and particle number. If, e.g., CO₂ is not of interest the values can be indicated as a negative number, meaning that data are missing. As mentioned above, you should make efforts to have reasonable values for NO₂, NO and ozone, as chemical reactions will otherwise not be taken correctly into account. Details on treatment of missing values can be found in the appendix, section 7.3.6.

There is a sample of such a data set as

TestData\VariousOML_files\RegionalBackgroundConc.dat

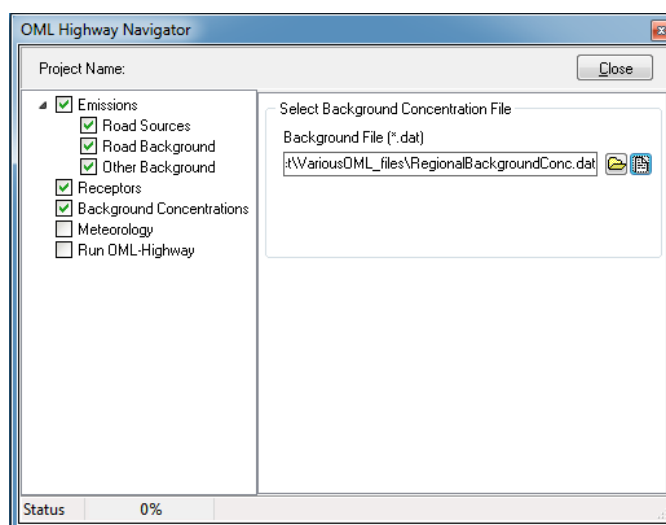


Figure 5.20. OML-Highway Navigator. Dialogue where a file with background concentration data is included in the SELMA^{GIS} project.

5.9 Meteorology

The meteorological data used for OML-Highway is a time series for one point, which represents meteorological conditions in the entire modelling area. In OML-Highway you can either use your own tools to produce a *.met file in the correct format (*.met), or you can supply meteorology data in the form of a *.txt file, from which a *.met file is generated with a meteorological preprocessor. Such a preprocessor is accessible by using the button “Create OML meteorological file” in Figure 5.21.

The first option where you provide a ready-made *.met file require that you have access to certain advanced parameters (e.g. friction velocity and mixing height), not just those directly observed at ordinary meteorological stations. This can be obtained by using a meteorological model and applying appropriate post-processing. There is further information on the contents and structure of *.met files in the Appendix, Section 7.3.7.

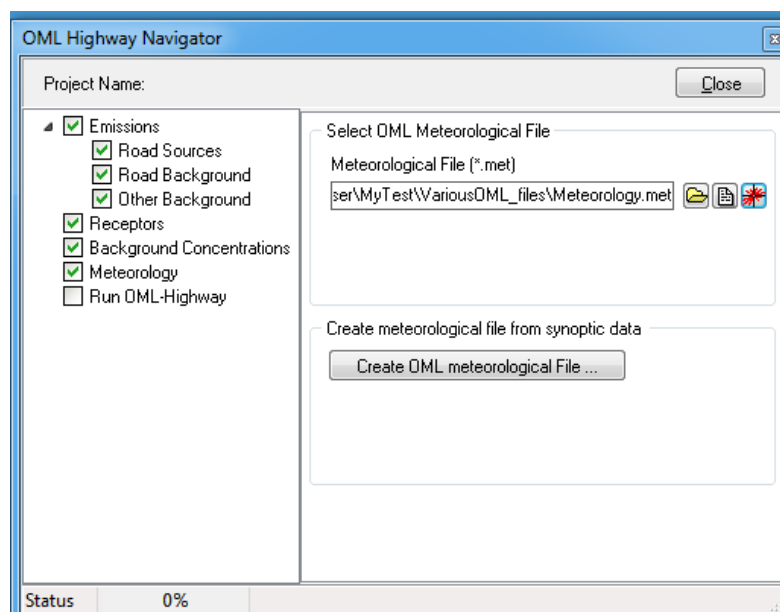


Figure 5.21. OML-Highway Navigator. The menu where the meteorological file is specified. Note the third button next to the field with the name of the *.met file. This button gives access to a wind rose based on the meteorological data file.

In Figure 5.21 the meteorological file specified is taken from the sample package: TestData\VariousOML_files\Meteorology.met

These data were generated with the MM5 meteorological model and subsequently post-processed.

By pressing “Create OML meteorological file” the user gets the opportunity to create data according to the second option mentioned above, where the user supplies a *.txt file with wind speed, temperature and various other information, and subsequently can run a meteorological preprocessor to create the data file. There is a sample file for this purpose in TestData\VariousOML_files\Kastrup_2005_SynopticMet.txt, and an explanation of the file in the Appendix, section 7.3.8.

5.10 Run OML-Highway

To run the calculations and analysis of OML-Highway you should proceed to the last label in OML-Highway Navigator: “Run OML-Highway” as shown in Figure 5.22.

Here you should specify the calculation period and the name and location for the output file. For the sample data, the relevant year is 2009, as the background concentrations and the file Meteorology.met refer to that year.

You can only start a calculation if there are green checkmarks at all previous steps in the process (with the possible exception of “Other Background”). If the button to start the calculation isn’t active, you should check your specifications concerning “Other Background” emissions. In that menu, you must make sure to remove the checkmark, which may be set at “Select Other Background Emissions” (Figure 5.15).

OML-Highway makes calculations for each hour in the calculation period. Output files are divided into two groups: statistics and time series. For each run of OML-Highway seven files with statistics are produced. These are, e.g., average values for the calculation period, and the maximum of hourly values for the calculation period. Further, a log file with the same name as the statistics is produced. More information on statistics files is found in the Appendix, Section 7.3.9.

As a user you should specify a file name for files with statistics without indicating any extension. During the OML-Highway run the seven statistics files are created. They bear different extensions, thus allowing you to identify their content. In addition, a log is produced in a file with extension *.log.

The second “group” of output files consists of one file only: An *.out file, which contains a time series of concentrations for receptors according to your specifications. This specification is given by an attribute in the receptor file: If the field RFTIMES is 1 (instead of 0) an hourly series of concentrations for that receptor is included in the *.out file. The format of an *.out file is described in the Appendix, Section 7.3.10.

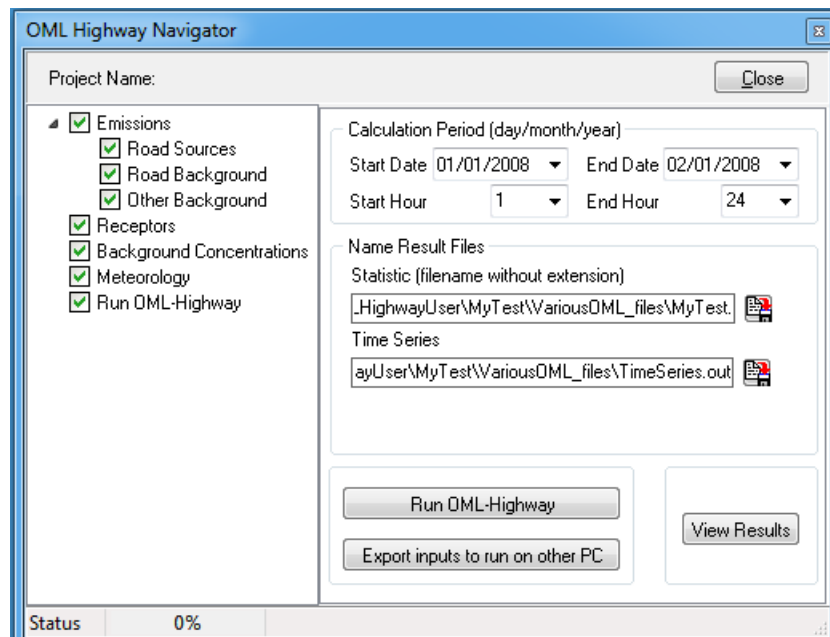


Figure 5.22. OML-Highway Navigator. Dialogue to run OML-Highway.

You start a run by pressing the button *Run OML-Highway*.

After the run you are asked whether you wish to see the log file. The log file gives an overview of input data and contains summary tables of results. It is located in the same folder as the files with statistics.

Subsequently, you may choose “View results”. This is the step to take if you wish to visualize the results in ArcMap. In the window that appears (Figure 5.23) you should specify location and name for the result files which have been produced (just point to an arbitrary file among those with statistics), and for a shapefile with results to be produced. Then press Start.

A shapefile will be produced, containing statistics for the various components (PM_{2.5}, NO₂ etc.) and parameters (annual average, 19th highest hourly value, etc.). See the Appendix, section 7.3.9 for further details.

Subsequently you can use ArcMap to visualize the results, e.g. by colour-coding concentrations values in the receptor points as illustrated in Figure 5.24.

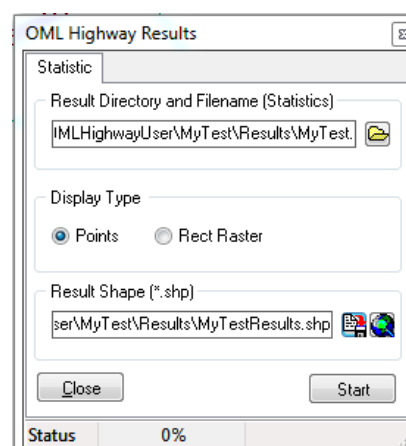


Figure 5.23. Dialogue to process results for viewing them as a shapefile.

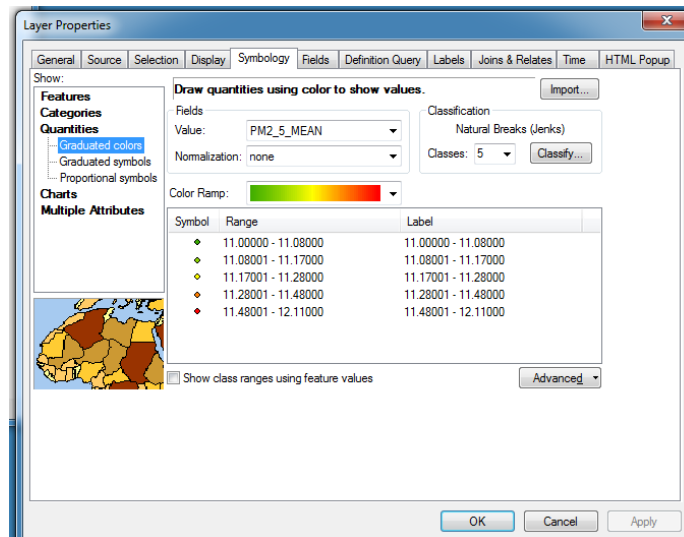


Figure 5.24. Setting colour-coding for visualisation of mean value of PM_{2.5}.

5.10.1 Exporting inputs

The menu in Figure 5.22 gives you the option to export all input files, so they can be run on another PC. You may also wish just to export the input to another folder in order to get less clutter with a large number of files in the folder where you currently work.

Choosing the export option means that all necessary input files for an OML-Highway run are copied to a single folder (with flat structure). A run can be performed by creating a .bat file with a content of a single line in that folder, and subsequently executing it. The contents of the .bat file should be:

```
c:\apps\selmagis\omlhw\OML-hw.exe OML-Highway.ini /Wl,Rm>Error-OML.txt
```

provided the export folder is on a PC with an OML-Highway installation. Otherwise, you can copy the OML-Highway executable to the folder and simplify the .bat file to

```
OML-hw.exe OML-Highway.ini /Wl,Rm>Error-OML.txt
```

The executable can be found as C:\Apps\SelmaGis\OMLHW\OML-hw.exe

5.11 SELMA^{GIS} toolbar – remaining items

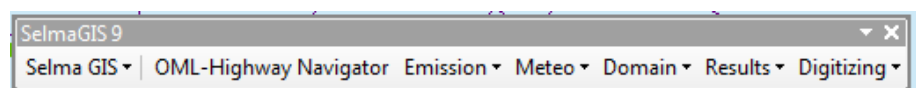


Figure 5.25. SELMA^{GIS} toolbar. The toolbar can be floating or docked. If docked, the left edge is a handle that can be used to move the toolbar.

In the preceding sections, focus has been on two of the items on SELMA^{GIS} toolbar, namely the SELMA^{GIS} menu and the OML-Highway Navigator button.

There are several remaining items on the toolbar. However, nearly all of these offer just an alternative way of accessing the dialogs that are described in relation to OML-Highway Navigator.

The only exceptions are:

- Visualisation of noise barriers via the menu item *Results*
- The menu item *Digitizing* that enables the user to edit certain features of the road network (presence of noise barrier) and of receptor points (receptor height, terrain height, and whether a time series of concentrations for the receptor point should be saved).

Visualisation of noise barriers is described in the next section.

For help on the Digitizing menu, consult the SELMA^{GIS} help (section 5.2 explains how to access the help).

5.11.1 Results - Visualisation of noise barriers

From the Results menu you can choose “Visualise Noise Barriers”. This is only relevant if your Road Network Shapefile contains data that specify noise barriers.

These data are indicated in two fields of the input road network shapefile. They are: NDistance and NSide. A description of these parameters is given in the Appendix, Table 7.2.

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7 Appendix

This appendix contains the following sections:

- Conventions
- Guide to file extensions
- Description of input files
 - Road network shapefile (RNS)
 - *.art – ARea Target
 - *.det – Diurnal Emission Variation
 - *.arb – ARea Background
 - *.deb – Diurnal Emissions Background
 - *.dat – regional background concentrations
 - *.met – meteorological input
 - *.txt – meteorological input to be preprocessed
 - output files with statistics
 - *.out – time series of calculated concentrations
- Configuration file SelmaGIS.ini
- Description of sample data
- Definition of “day case”

Note that section 7.2 “Guide to file extensions” is very useful as a reference.

7.1 Conventions

Time format: values 1-24 indicate the end of the hour for which averages are given.

In data files in text format OML-Highway uses as decimal separator a “.” (period). This should also be the system setting when working with OML-Highway.

SELMA^{GIS} versions distributed prior to November 15, 2014 produce files where the variable IDTRAFCCAT is named IDDIURNAL (this is a setting in the configuration file SelmaGIS.ini).

In the description given in the present user guide we assume that SELMA^{GIS} has been installed in folder C:\Apps\SELMAGIS and WinOSPM in folder C:\Apps\WinOSPM.

7.2 Guide to file extensions

Table 7.1. Guide to file extensions (continued on next page).

Extension	Mnemonic	Explanation	Produced by
arb	Area Road Background	Text file with gridded information on emission from background roads. Does not include information on variation with time. See Appendix, section 7.3.4 for a description.	SELMAGIS
aro	ARea Other	Optional text file for providing information on other background sources than roads.	The user; no tool available.
art	ARea Target	Text file to provide information on all target road segments, the amount of traffic they carry, and Traffic Composition ID. Does not include information on variation with time. See Appendix, section 7.3.2 for a description.	SELMAGIS
dat		Text file to provide information on regional background concentrations. See Appendix, section 7.3.6 for a description.	The user; no tool available.
deb	Diurnal Emissions Background	Text file resembling a *.det file, see below; however, a *.deb file refers to background road emissions. A sample is provided, which may be acceptable for direct use. See Appendix, section 7.3.5 for a description.	The user; no tool available.
det	Diurnal Emission variation for Tar- get roads	Text file, "Diurnal Emission Variation File". Information on the time variation of emissions from target road sources. There is a group of lines for each Traffic Composition Category. Within each such group, there is a line for each hour of day and each "day case" (defined in appendix, Table 7.11), i.e. $24 \times 8 = 192$ lines. The table of emissions is normalized to an AADT of 10,000. See Appendix, section 7.3.3 for a description.	SELMAGIS
emi		Text file with annual emissions for each segment of the target roads. The name includes the string "RSC" (Road Source Characteristics)	SELMAGIS
flf	Fuel List File	Text file in format developed for WinOSPM. Contains pointers to other files with data on the fuel composition, as well as expressions used for calculation of the emission factors. See OS PM manual for explanation.	WinOSPM
H19HrM		Statics; output from OML-Highway run.	OML-Highway run
H26D8hr		Statics; output from OML-Highway run.	OML-Highway run
H36DayM		Statics; output from OML-Highway run.	OML-Highway run
H8DayM		Statics; output from OML-Highway run.	OML-Highway run
ini		SelmaGIS.ini is a text file with configuration parameters for SELMAGIS. Located in the same folder as the SELMAGIS executable. The user should normally not change this file. See Appendix, section 7.4 for a description.	Intrinsic
log		Log. Running OML-Highway produces a log file.	OML-Highway run
Max1hr		Statics; output from OML-Highway run.	OML-Highway run
Max8hr		Statics; output from OML-Highway run.	OML-Highway run

Table 7.1. (continued) Guide to file extensions.

Extension	Mnemonic	Explanation	Produced by
mdb		Access data base with kilometers travelled in each background grid cell. There are data for each of five background road types.	SELMAGIS
mean		Statics; output from OML-Highway run.	OML-Highway run
met		Meteorological file in format appropriate for OML-Highway.	SELMAGIS or External
mxd		ArcMap project.	ArcMap
out		Output from OML-Highway run in the form of a time series of concentration values for selected receptors.	OML-Highway run
prj		Information on geographic projection.	SELMAGIS
rct	ReCepTor	Receptor data.	SELMAGIS
sel	SELMAGIS	SELMAGIS project file.	Intrinsic
shp, BSF		Background Sources Shapefile (BSF).	SELMAGIS
shp, GBS		Grid for Background Sources Shapefile (GBS).	SELMAGIS
shp, RNS	Road Network File	Road Network Shapefile (RNS).	External
shp, RSC	Road Source Characteristics	Road Source Characteristics Shapefile (RSC).	SELMAGIS
shp, RSC		Road Emission Shapefile (RSC).	SELMAGIS
shp, RSF		Receptor Characteristics Shapefile (RSF).	SELMAGIS
trf	Traffic	Diurnal Traffic variation file, e.g. Type_A.trf. Described to some extent in section 2.4; more detailed explanation in OSPM manual.	WinOSPM
txt		Used for meteorological input to be treated by met. preprocessor. See Appendix, section 7.3.8 for a description.	WinOSPM
vlf	Vehicle List File	Text file in format developed for WinOSPM. Contains pointers to other files, which actually contain data used for calculations of emission factors. See OSPM manual for explanation.	WinOSPM
xls		Used for Traffic Composition Category file.	SELMAGIS

7.3 Description of input files

7.3.1 Road network shapefile

A network shapefile contains characteristics of either target roads, background roads, or both types of roads. The field Tflag indicates the type of the road. This file must be constructed by the user before running OML-Highway. However, the two last parameters in the table (Nside and ID-TRAFCCAT) are calculated by SELMA^{GIS}.

Table 7.2. Definition of fields in the road network shapefile. The column Target/Background indicates whether the parameter is relevant for Target roads, Background roads or both.

Fieldname	Data description	Target/Background	Format
Shape	Polyline	Both	Geometry
RoadID	Unique number	Both	Integer
Roadtype	ID for road type used for background roads to characterise their traffic conditions. Five types are used (2111, 2112...), see section 2.6.	Background	Integer
Doubled	Double digitized = 2, otherwise = 1. For double digitized roads there are two close, approximately parallel road segments, each of which carries traffic in one direction. In chapter 2 on concepts this is further explained.	Target	Integer
AADT	Annual Average Daily Traffic (number)	Both	Float/Double
FPass	Fraction of passenger cars. Number between 0 and 1. The sum (FPass+FVans+FTrucks+FBus) should be 1.	Background	Float/Double
FVans	Fraction of vans. Number between 0 and 1. The sum (FPass+FVans+FTrucks+FBus) should be 1.	Background	Float/Double
FTrucks	Fraction of trucks. Number between 0 and 1. The sum (FPass+FVans+FTrucks+FBus) should be 1.	Background	Float/Double
FBus	Fraction of buses. Number between 0 and 1. The sum (FPass+FVans+FTrucks+FBus) should be 1.	Background	Float/Double
FHeavyDuty	Fraction <i>in percent</i> of heavy duty vehicles (sum of trucks and buses, but in percent).	Target	Float/Double
OSPMTYPE	Id for traffic type used for target roads to characterise their traffic conditions. An example is Type A.trf, which is a standard OSPM diurnal type. This is discussed in chapter 2 on concepts.	Target	Text
Roadwidth	Width of carriageway of road segment (m); if double digitized only one direction.	Target	Float/Double
SpeedLight	Speed of light traffic in km/h. This speed is a scaling speed which implicitly defines the speed of heavy traffic. The speed for an actual hour may be different and is computed based on information in *.trf files.	Both	Integer
DamH	Height of dam (positive) or cutting (negative) in relation to ground (m)	Target	Float/Double
WallH	Height of noise wall (m).	Target	Float/Double
EmbankH	Height of embankment (m).	Target	Float/Double
TFlag	Flag. 1 for target roads, 2 for background roads; records with other values are ignored.	Both	Integer
NDistance	Distance from road centre line to noise wall/embankment (m).	Target	Integer
NSide	Location of noise barrier in relation to the road follows the convention of OSPM (either 1 or 2); created by SELMA ^{GIS} .	Target	Integer
IDTRAFCCAT	Id for traffic composition categories; created by SELMA ^{GIS} . Note that SELMA ^{GIS} versions distributed prior to November 15, 2014 produce files where the variable IDTRAFCCAT is named IDDIURNAL.	Target	Integer

TargetRoadsOnly														
	FID	Shape	OBJEKTTYPE	VEJ_NAVN	AGTRAF2DIR	AADT	FPASS	FVANS	FTRUCKS	FBUS	DAMHEIGHT	WALLH	EMBANKH	TF
▶	0	Polyline	Vej over 6 m	Stenløsevej	1	17191	0.78	0.12	0.08	0.02	0	0	0	
	1	Polyline	Motorvej	Fynske Motorvej	2	6841	0.75	0.1	0.15	0	0	0	0	
	2	Polyline	Vej over 6 m	Svendborgvej	1	8498	0.78	0.12	0.08	0.02	0	0	0	
	3	Polyline	Motorvej		0	0	0.75	0.1	0.15	0	0	0	0	...

EMBANKH	TFLAG	NDISTANCE	IDDIURNAL	SPEEDLIGHT	FHEAVYDUTY	NSIDE	ROADTYPE	SHAPE_LENG	ROADWIDTH	OSPMTYPE	ROADID
0	1	0	1	70	10	0	2115	253.366166	10	Type_F.trf	712
0	1	0	2	120	15	0	2111	554.014766	10	Type_B.trf	851
0	1	0	1	70	10	0	2115	224.741008	10	Type_F.trf	1132
0	1	0	3	120	15	0	2111	441.546469	10	Type_A.trf	1180

Figure 7.1. Sample of shapefile. The number of parameters is large, so a snapshot of the file has been divided into a left part (on top) and a right part (below it). The sample contains more information than the required minimum.

7.3.2 Files of type *.art – ARea Target

An *.art file is a text file used by OML-Highway to provide information on all target road segments and the traffic they carry.

Table 7.3. Data structure of the *.art file ("ARea Target"). This is a text file with a 6-line header. Figure 7.2 shows a sample. This table describes the parameters in the body of the file.

Field name	Data description
ID	Source ID (for the road segment). A unique number. Called SOURCEID in RSC shapefile.
X	X-coordinate of the south west corner of the area source segment.
Y	Y-coordinate of the south west corner of the area source segment.
L1	Length of the first side of the area source when moving clockwise from southwest corner.
L2	Length of the second side. Max ratio L1/L2 for line sources is 1:10 (or 10:1).
TETA	Angle in degrees of L1 with respect to north values; 0-90 possible. Zero if L1 is North-South.
H_Rd	Height of the road/bridge in m.
H_DoC	Height of the dam/cutting in m.
AAdt	AADT annual average daily traffic in veh/day.
Id	Id for traffic composition categories, also referred to as IDTRAFCCAT in shapefiles.
Id	Source Id of the road segment in the opposite direction. Called OPPOSITEID in RSC shapefile.
Width	Total width over both directions. Called DOUBLWIDTH in RSC shapefile. Calculated by SELMA ^{GIS} .
Wall	Height of the noise barrier in m. Called WALLH in RSC shapefile.
Embankment	Height of the embankment in m. Called EMBANKH in RSC shapefile.

(Line no. 1-6 are not read.) (Free format)													
	(m)	(m)	(m)	(m)		-Height (m) -- road/ dam/ bridge cutting	(veh/day)	"ik'" Traffic compos. category	"SrcID" Opposite road direction	Both direction total	-Noise barrier--- Height(m)		
ID	X	Y	L1	L2	TETA	H_Rd	H_DoC	Aadt	Id	Id	Width	Wall	Embankment
1	587476.02	6135176	100	10	33.67	0	0	17191	1	-99	10	0	0
2	587531.47	6135259.22	100	10	33.67	0	0	17191	1	-99	10	0	0
3	587586.91	6135342.44	53.11	10	33.67	0	0	17191	1	-99	10	0	0
4	587350.84	6134950.71	10	80.62	18.19	0	0	6841	2	133	35.87	0	0
5	587427.94	6134925.41	10	100	12.08	0	0	6841	2	132	28.62	0	0
6	587525.73	6134904.48	10	66.71	12.08	0	0	6841	2	-88	10	0	0
7	587591.24	6134890.47	10	100	8.83	0	0	6841	2	-88	10	0	0
8	587690.06	6134875.12	10	100	8.83	0	0	6841	2	-88	10	0	0
9	587788.87	6134859.76	10	100	8.83	0	0	6841	2	-88	10	0	0
10	587887.69	6134844.41	10	6.39	8.83	0	0	6841	2	-88	10	0	0
11	590274.91	6133903.24	10	100	27.04	0	0	8498	1	-99	10	0	0
12	590185.84	6133948.7	10	100	27.04	0	0	8498	1	-99	10	0	0
13	590163.83	6133959.94	10	24.71	27.04	0	0	8498	1	-99	10	0	0
14	592193.1	6134571.03	100	10	66.43	0	0	0	3	-99	10	0	0

Figure 7.2. Sample of an *.art file. The sample shown has been reformatted slightly for legibility.

7.3.3 Files of type *.det – Diurnal Emission Variation

A "Diurnal Emission Variation File" is a text file providing information on the time variation of emissions from target road sources. It is created by SELMA^{GIS}. There is a group of lines for each Traffic Composition Category. Within each such group, there is a line for each hour of day and each "day case", i.e. $24 \times 8 = 192$ lines. The table of emissions is normalized to an AADT of 10,000. The definition of day cases is given in the Appendix, Section 7.6.

The file is used by OML-Highway as a lookup table for emissions.

Table 7.4. Data structure of the *.det file ("Diurnal Emission variation for Target roads"); emissions normalized to annual average daily traffic (AADT) of 10,000 vehicles

Fieldname	Data description
ID	ID for traffic composition category, also referred to as IDTRAFCCAT in shapefiles.
Weekday	Number of the day of the week; Monday = 1.
Mth	Number of the month; January = 1.
Day-Case	8 "day-cases" are defined, e.g. "Fridays in July". Defined in the Appendix, Section 7.6.
Hr	Hour of the day; 1 – 24.
Nlight	Number of light vehicles during the hour considered.
Nheavy	Number of heavy duty vehicles during the hour considered.
Speed Vlight	Speed of light traffic in km/h.
Speed Vheavy	Speed of heavy duty traffic in km/h.
NOx	Emission in $\mu\text{g}/\text{m}/\text{s}$.
fractionNO2	Emission in %.
CO	Emission in $\mu\text{g}/\text{m}/\text{s}$.
CO2	Emission in $\mu\text{g}/\text{m}/\text{s}$.
PMexhaust	Emission in $\mu\text{g}/\text{m}/\text{s}$.
PM2.5	Emission in $\mu\text{g}/\text{m}/\text{s}$.
PM10	Emission in $\mu\text{g}/\text{m}/\text{s}$.
Pnumber	Particle number in $\#/ \text{m}/\text{s}$.

Number and order of parameters/components are fixed. Emissions are normalized to annual daily traffic (ADT) of 10,000 vehicles.
 (Line no. 1-6 are not read. Missing emission values are negative.
 (Free format)

ID	Week- day	mt	Day- Case	hr	Nlight	Nheavy	Speed Vlight	Speed Vheavy	($\mu\text{g}/\text{m}/\text{s}$) QNOx	(%) fractionNO2	----- ($\mu\text{g}/\text{m}/\text{s}$) QCO	QCO2	QPMExh
1	1	1	1	1	67.88519	11.48254	64.8	52.8	10.87495	15.20411	11.01438	5270.50888793945	9.475207E-02
1	1	1	1	2	38.0707	4.268776	67.8	56.4	4.733544	17.27082	5.516197	2496.04145770264	4.092173E-02

....

Figure 7.3. Sample of *.det file. ID in the first column refers to Traffic Composition Category. The file is wider than shown. The sample shown has been reformatted slightly for legibility.

7.3.4 Files of type *.arb – ARea Background

A file of type *.arb is a text file, which describes cells with gridded emission data. It concerns emission from background roads. Each record describes the geometry and annual emission of one cell.

Table 7.5. Data structure of the *.arb file ("ARea Background"). This is a text file with a 6-line header.

Field name	Data description
ID	ID for background source. A unique number.
X	X-coordinate of the lower left corner of the area source.
Y	Y-coordinate of the lower left corner of the area source.
L1	Length of the first side of the area source when moving clockwise from southwest corner
L2	Length of the second side. Max ratio L1/L2 for line sources is 1:10 (or 10:1).
TETA	Angle in degrees of L1 with respect to North; values 0-90 possible. Zero if L1 is North-South
HS	Height of the release from background source in m. The default value is 1 m.
HB	Parameter with a default value of 3 m. Ensures a suitable initial dispersion for the area source, taking traffic produced turbulence into account.
Id	ID of the traffic composition category for background roads. For background roads, only a value of 1 is currently used.
QNOx	Emissions in kg/year
fractionNO2	Emission fraction of NO ₂ in %.
QCO	Emissions in kg/ year.
QCO2	Emissions in kg/ year.
QPMExh	Emissions in kg/ year.
QPM2.5	Emissions in kg/ year.
QPM10	Emissions in kg/ year.
QPNumber	Particle number in 10 ¹⁴ #/ year.

Number and order of parameters/components are fixed. (Line no. 1-6 are not read.
Missing emission values are negative.

Traffic compos.																
(-)	(m)	(m)	(m)	(m) (deg)	(m)	(m)	category	(kg/year	(%)	(kg/year)	(kg/year)	(kg/year)	(kg/year)	(kg/year)	(kg/year)	(10 ¹⁴ #/yr)
ID	X	Y	L1	L2	TETA	HS	HB	Id	QNOX	fractionNO2	QCO	QCO2	QPMExh	QPM2.5	QPM10	QPNumber
1	570700	6129800	1000	1000	0	1.0	4.0	1	360.4322	24.13512	789.705	155966.5314449219	7.246446	20.8284	52.53595	309654.4
2	571700	6129800	1000	1000	0	1.0	4.0	1	96.42887	21.59819	329.0174	49854.6120634766	2.171314	6.349024	15.58568	72151.63
3	572700	6129800	1000	1000	0	1.0	4.0	1	295.5294	24.24422	618.3944	125872.345769531	5.884074	16.88584	42.6975	256538.6
4	573700	6129800	1000	1000	0	1.0	4.0	1	211.6069	24.13281	464.0358	91594.7706171875	4.255135	12.23087	30.84874	181758.8
5	574700	6129800	1000	1000	0	1.0	4.0	1	201.263	22.70435	599.8583	98059.1344921875	4.360292	12.67854	31.40097	158479.8

Figure 7.4. Sample of an *.arb file. The sample shown has been reformatted slightly for legibility.

7.3.5 Files of type *.deb – Diurnal Emissions Background

A "Diurnal Emission Background file" is a text file. It provides information on the diurnal variation of emissions from the background roads. The file contains diurnal emission profiles that are normalized to 1 for all pollutants. There is no tool in SELMA^{GIS} to produce this file. If data for the area of interest are available the user can create this file manually. Otherwise, the sample *.deb file provided with the installation package can be used if seen appropriate for the region. Typically, a precise description of the diurnal variation of emissions for background roads will be less important than the diurnal variation for target roads, and therefore use of the sample file will be acceptable.

Table 7.6. Data structure of the *.deb file ("Diurnal Emissions Background").

Fieldname	Data description
ID	Id of the traffic composition category for background roads. For background roads, only a value of 1 is currently used in the calculations (a value of 2 appears in the sample file, but is not used).
Weekday	Number for the day of the week; Monday = 1
Mth	Number of the month; January = 1
Day-Case	8 "day-cases" are defined, e.g. "Fridays in July". Defined in the Appendix, Section 7.6.
Hr	Hour of the day; 1 - 24
QNOx	Relative diurnal emission factors: daily average = 1
fractionNO2	Relative diurnal emission factors: daily average = 1
QCO	Relative diurnal emission factors: daily average = 1
QC02	Relative diurnal emission factors: daily average = 1
QPM2.5	Relative diurnal emission factors: daily average = 1
QPM10	Relative diurnal emission factors: daily average = 1
QPnumber	Relative diurnal emission factors: daily average = 1

Number and order of parameters/components are fixed. Numbers are relative diurnal emission factors: weighted annual average = 1.
Line no. 1-6 are not read. Missing emission values are negative.
(Free format)

ID	Week-day	mth	Day-Case	hr	QNOx	fractionNO2	QCO	QC02	QPMExh	QPM2.5	QPM10	QPnumber
1	1	1	1	1	0.323610566	1.007191327	0.277125491	0.172092086	0.279445178	0.279963294	0.281721667	0.218923866
1	1	1	1	2	0.155462317	0.973331139	0.149319823	0.070689544	0.129831099	0.134991585	0.140271126	0.079069304
1	1	1	1	3	0.111933197	0.986848682	0.10184535	0.056047969	0.093740642	0.096432242	0.099816358	0.073107681

Figure 7.5. Sample of *.deb file. The sample shown is the one provided with an OML-Highway installation.

7.3.6 Files of type *.dat – regional background concentrations

Data for hourly values of regional background concentrations should be provided in a text file with extension *.dat. Such data may have been acquired by monitoring or modelling.

Values are required for the following compounds: NO_x, NO₂, O₃, CO, CO₂, PM_{2.5}, PM₁₀ and particle number. Missing values are indicated by negative numbers. In the file, the order and number of parameters is fixed, but you may for instance disregard a component by indicating missing values for all hours.

Missing values (negative numbers) are handled in the following way:

- If the first line in the file contains missing values for a component, values for all subsequent hours for that component are assumed to be missing.
- If there are missing data later in the file the model “fills” the missing data with the values from the previous valid hour. For longer periods of missing data (days, weeks) this might appear inappropriate and the user should take care to remove these results in the output.
- If one of the components NO₂, NO and ozone is missing, all three components are replaced with the previous complete valid set of these components.

Table 7.7. Data structure of the *.dat file with regional background concentrations.

Fieldname	Data description
DATE	Date in format yyyyymmdd
HR	Hour of the day; 1 - 24
NOX	Concentration as µg-NO ₂ /m ³
NO2	Concentration in µg/m ³
O3	Concentration in µg/m ³
CO	Concentration in µg/m ³
CO2	Concentration in µg/m ³
PM2.5	Concentration in µg/m ³
PM10	Concentration in µg/m ³
PNumber	Particle number in #/cm ³

```

Number and order of parameters/components are fixed. Free format.                                Regional background.
Line no. 1-6 are not read.
All units are in ug/m3 except for NOx (ug-NO2/m3) and for 'PNumber' of Particles (#/cm3).
Missing concentration values are negative.
  yyyyymmdd
DATE  HR   NOX   NO2    O3    CO   CO2  PM2.5  PM10  PNumber
20080101 1   2.24  1.56  55.00  250  -9.9   11    19    3000
20080101 2   1.57  1.05  62.35  250  -9.9   11    19    3000
20080101 3   0.74  0.34  63.87  250  -9.9   11    19    3000

```

Figure 7.6. Sample of *.dat file with regional background concentrations.

7.3.7 Files of type *.met with meteorological input

A user of OML-Highway can either (1) supply meteorology data in the form of a *.met file with ready-made data in the correct format, or (2) provide a *.txt file, from which a *.met file is generated with a meteorological preprocessor built into OML-Highway.

Use of the first option requires that the user has access to certain advanced parameters (e.g. friction velocity and mixing height), not just those directly observed at ordinary meteorological stations. This can be obtained by using a meteorological model and applying appropriate post-processing.

The first option can potentially yield data of higher quality than the second. This is because the meteorological preprocessor is a simplistic special version of the OML meteorological preprocessor. It requires only synoptic data (not radiosonde data), and it uses various simplifying assumptions, especially in calculation of mixing height.

This section gives the specifications for the *.met file used by the first option.

A sample of such a file is provided in the sample data set,
TestData\VariousOML_files\Meteorology.met

This approach requires that the user has access to certain advanced meteorological parameters (e.g. friction velocity and mixing height), not just those directly observed at ordinary meteorological stations. This can be obtained by using a meteorological model and applying appropriate post-processing.

The file contains hourly meteorological data. It has a 10-line header, followed by 8,760 (or 8,784) records for a full year's worth of data. For the period with data the time series is expected to be complete without interruptions. The data structure of records is shown as Table 7.8 and the first lines of the sample in Figure 7.7. More details are given after the figure.

Table 7.8. Data structure of records in a *.met file

Fieldname	Data description
DATE	Date in format yyyyymmdd.
Hr	Hour in local standard time, 1-24 (end of averaging period).
AL	Monin-Obukhov length (m).
DD	Wind direction in degrees. 360 is North, while 0 is not allowed.
DELDD (or short: DLD)	Delta of the wind direction in degrees. Described in section 7.3.8.
HSTAR	Buoyancy heat flux in unit $0.001 \text{ m}^2/\text{s}^3$.
SZI	Stability parameter s_i for layer above z_i in unit 0.001 s^{-2} . -9.9999 for missing.
SZLID	Stability parameter s_i for layer above z_{lid} in unit 0.001 s^{-2} . -9.9999 for missing.
SZMIX	Stability parameter s_i for layer above z_{zmix} in unit 0.001 s^{-2} . -9.9999 for missing.
TT	Temperature (Kelvin).
UST	Friction velocity (m/s).
WST	Convective velocity (m/s).
ZI	Convective mixing height (m). -1 for missing.
ZLD	Height of "sustained lid" base (m). -1 for missing.
ZMIX	Operational mixing height (m).
Z0	Roughness length, m.
TD	Not used. You may e.g. indicate -1.
CLD	Not used. You may e.g. indicate -1.
RAD	Global radiation, W/m^2 .

```

Gis-format          (Identifier for special format used by OML-Highway in SelmaGIS)  (Free format)
Odense_Syd_HW      (STATION NAME, max 14 char. no spaces)
Fine               (Coarse or Fine: Coarse if wind direction is indicated in tens)
55.35 LST 0.35     (STATION Latitude(degrees), STATION Time(LST or GMT), Kappa(0.35 or 0.40))
Optional text (line no. 5-10 are not read):
FILE CREATED:20110203 from MM5. Rad added, missing filled in , last line added
(Td and Cld are not used by OML-Highway)
DATE  HR  AL  DD  DLD  HSTAR  SZI  SZLID  SZMIX  TT  UST  WST  ZI  ZLD  ZMIX  Z0  Td  Cld  Rad
          (m) (Deg) (Deg) (1000*  (1000*  (1000*  (1000*
          m2/s3) /s2) /s2) /s2)
yyyyymmdd      (m) (Deg) (Deg) m2/s3) /s2) /s2) /s2) (K) (m/s) (m/s) (m) (m) (m) (m) (m) (m) (m) (m) (m)
20080101 1 -689.84 13 1 0.177 -9.9999 -9.9999 0.1 274.8 0.35 0.356 -1 -1 255 0.050 273 0.46 0.2
20080101 2 -845.71 14 1 0.143 -9.9999 -9.9999 0.1 274.6 0.349 0.333 -1 -1 258 0.050 272.9 0.49 0.2
20080101 3 -722.15 15 1 0.161 -9.9999 -9.9999 0.1 274.5 0.344 0.345 -1 -1 255 0.050 272.9 0.5 0.2
20080101 4 -617.96 16 1 0.169 -9.9999 -9.9999 0.1 274.5 0.332 0.317 -1 -1 189 0.050 272.9 0.5 0.1
20080101 5 -657.67 17 0 0.159 -9.9999 -9.9999 0.1 274.4 0.332 0.345 -1 -1 257 0.050 272.9 0.5 0.2
20080101 6 -651.49 17 1 0.161 -9.9999 -9.9999 0.1 274.4 0.333 0.314 -1 -1 191 0.050 273.2 0.49 0.2

```

Figure 7.7. The first lines of the sample file Meteorology.met with preprocessed meteorological input for OML-Highway in the *.met format. Slightly reformatted for readability. The text in red is ignored by the program (comments for guidance).

The contents of the file is further specified below.

Values in a .met file are read using free format, i.e. they should be separated by at least one blank, but it is unimportant whether they are in certain columns.

The file has a 10-line header. Figure 7.7 is useful as illustration. The text in dark red is ignored by the program, but explains the parameters. The parameters in the header are:

- Line 1: “Gis-format”. This keyword is mandatory for *.met input files to be used by OML-Highway.
- Line 2: STATION_NAME. Any name of your choice, max. 14 characters. Blanks are not permitted.
- Line 3: The keyword “Coarse” or “Fine”. Use “Coarse” if the wind direction is in tens of degrees, e.g. 10, 20 etc. If the measured wind direction is indicated with a resolution of 1 degree, you should use the keyword “Fine”. The wind direction should be given as integers, no matter which keyword you use. If the option “Coarse” is used, a random number function will be applied internally in OML-Highway to distribute wind directions evenly in ten degree intervals. For instance, instead of an indicated value of 10 a random value between 5 and 15 will be applied. If your data have different resolution (e.g. 22.5 degrees), you must make your own preprocessing before supplying the data to OML-Highway.
- Line 4: Three parameters should be given. First the latitude of the met station; next the keyword “LST” (Local Standard Time) or “GMT” depending on your convention when indicating time in the meteorological file; and finally either the value 0.35 or 0.40. This number is the value of the von Karman constant used when computing the various parameters. Files created with the OML preprocessor use a value of 0.35 for the von Karman constant, whereas e.g. AERMOD uses 0.40.

Lines 5-10 are not read by OML-Highway, but can contain comments.

The records in line 11 onwards contain values of the various parameters. For most parameters it is not permitted to have missing values, but for some a missing value can be flagged as specified below. The list below provides further explanation of certain variables:

- HSTAR. The buoyancy heat flux HSTAR can be calculated from sensible heat flux at the surface (HF) by the equation $HSTAR = HF * g / (T * \rho * c_p)$ where g is the gravitational acceleration, T the surface temperature in Kelvin, ρ the density of air, and c_p the specific heat capacity of dry air at constant pressure. This amounts to approximately $HSTAR (m^2/s^3) = HF (W/m^2) * 2.76 * 10^{-5} (m^4/(Js^2))$ (however with temperature dependence). In the OML input file the unit $0.001 m^2/s^3$ is used for HSTAR, implying that e.g. a sensible heat flux of $100 W/m^2$ is indicated as (approximately) the value 2.76 in the OML input file.
- Boundary layer height. OML uses a height of the convective boundary layer (ZI) and an operational mixing height (ZMIX), which may

be the same value. OML requires information about the lapse rate (the stability parameter) in the layer above these two heights. Furthermore, the OML meteorological preprocessor uses the concept of a “sustained lid” which may be present and limit mixing.

If you prepare your data by other means than the OML preprocessor you can flag the parameters relating to a sustained lid (SZLID and ZLD) as missing. A missing value of ZI or ZLD is indicated as -1. Missing values of ZMIX are not permitted.

- Stability parameter (SZI, SZLID and SZMIX). These parameters can be computed from the lapse rate in the relevant layer as follows:

$$SZI (s^{-2}) = \gamma * g / T$$
 where γ is the potential temperature gradient in the layer (K/m), g the gravitational acceleration (m/s^{-2}), and T the temperature (K). SZI refers to the layer above the convective mixing height, and SZMIX to the layer above the operational mixing height. The value must be determined from available information. Missing values of either of the stability parameters are allowed and are indicated as -9.9999. In the OML input file the unit $0.001 s^{-2}$ is used for SZI etc., implying that e.g. a potential temperature lapse rate of 10 K/km results in a value of approximately 0.36 in the OML input file.
- Convective velocity WST. This is a convective scaling velocity defined as $(ZI * HSTAR)^{1/3}$ where ZI is the convective boundary layer height. It is 0 m/s for night time conditions. In the OML preprocessor WST is computed for all daytime hours, based on the operational mixing height ZMIX when ZI is undefined.
- RAD: Global radiation in W/m². Global radiation is incoming solar radiation, both directly from the sun and scattered by clouds. At night its value is 0, during daytime its value is positive. RAD may be missing. Indicate missing values as -99. In some contexts you may encounter the name “GL” instead of RAD.

7.3.8 Files of type *.txt with meteorological input

A user of OML-Highway can either (1) supply meteorology data in the form *.met file with ready-made data in the correct format, or (2) provide a *.txt file, from which a *.met file is generated with a meteorological preprocessor built into OML-Highway.

It should be noted that the meteorological preprocessor is a simplistic special version of the OML meteorological preprocessor. It requires only synoptic data (not radiosonde data), and it uses various simplifying assumptions, especially in calculation of mixing height. The first option where a user provides a ready-made *.met file can potentially yield data of higher quality.

This section gives the specifications for the *.txt file used by the second option.

A sample of such a file is provided in the sample data set,
 TestData\VariousOML_files\Kastrup_2005_SynopticMet.txt

The file contains hourly meteorological data. It has a 10-line header, followed by 8760 (or 8784) records for a full year’s worth of data. For the period with data the time series is expected to be complete without interruptions.

The data structure of records is shown as Table 7.9 and the first lines of the sample in Figure 7.8. More details are given after the figure.

Table 7.9. Data structure of records in the *.txt file to be converted to *.met.

Fieldname	Data description
DATE	Date in format yyyyymmdd.
Hr	Hour in local standard time, 1-24 (end of averaging period)
Cir	Indicates whether cirrus is the dominating cloud type. 0 or 1. Use 1 if cirrus is dominating, use 0 if it isn't, or if this information is missing.
DD	Wind direction in degrees. 360 is North, while 0 is not allowed.
DELDD	Delta of the wind direction in degrees.
QUAL	User-defined quality indicator.
FF	Wind speed in m/s.
HUM	Humidity in %.
NN	Cloud cover in eights (1-8).
RA	Indicates whether it has rained or not during previous hour (0 or 1, 0 for no rain).
SN	Indicates whether the ground is more than half covered with snow (0 or 1, 0 for no snow).
TC	Temperature in Celsius.
RAD	Global radiation, W/m ² .
Z0	Estimated roughness length, m.

```

Synopformat_1      (Identifier for the file format)      (Free format)
Kastrup            (STATION_NAME, max 14 char. no spaces)
Coarse             (Coarse or Fine: Coarse if wind direction is indicated in tens).
Latitude Longitude AnemometerHeight Thermometer height Option_RSopt Timeshift Force_cloud_use
55.63             12.64           8.0              2.0              1              1              0

      DATE      Hr      Cir      DD DELDD  QUAL      FF      HUM      NN      RA      SN      TC      Rad      z0
20050101        1        0      300.  20      0  2.6      99      8      0      0      2.6     -99     0.03
20050101        2        0      280.  20      0  3.1      99      7      0      0      2.0     -99     0.03
20050101        3        0      260.  10      0  4.1      99      7      0      0      2.3     -99     0.03
20050101        4        0      280.  10      0  5.1      99      8      0      0      1.9     -99     0.03
20050101        5        0      260.  10      0  4.1      99      8      0      0      0.9     -99     0.03

```

Figure 7.8. The first lines of the sample file Kastrup_2005_SynopticMet.txt, providing meteorological data to be used as input for the met preprocessor in OML-Highway (its use is described in section 5.9).

The file has a 10-line header. In order to create your own file you should copy the header in the example with the following changes:

- Line 2: Replace “Kastrup” with a relevant station name. The name should be no longer than 14 characters and must contain no spaces.
- Line 3: The keyword “Coarse” or “Fine”. Use “Coarse” if the wind direction is in tens of degrees, e.g. 10, 20 etc. If the measured wind direction is indicated with a resolution of 1 degree, you should use the keyword “Fine”. The wind direction should be given as integers, no matter which keyword you use. If the option “Coarse” is used, a random number function will be applied internally in OML-Highway to distribute wind directions evenly in ten degree intervals. For instance, instead of an indicated value of 10 a random value between 5 and 15 will be applied. If your data have different resolution (e.g. 22.5 degrees), you must make your own preprocessing before supplying the data to OML-Highway.
- Line 5: Replace Latitude, Anemometer height and Thermometer height with relevant values. There should be at least one blank between parameters to separate them, but the exact position of the pa-

rameters doesn't matter. You should leave Longitude and Timeshift unchanged. Also leave other parameters in line 5 unchanged. The convention for time units in the subsequent lines is that you should use local standard time (not daylight saving time).

The records in line 11 onwards:

- The values are read using free format, i.e. they should be separated by at least one blank, but it is unimportant whether they are in columns.
- In general it is not permitted to have missing values. Exceptions to this rule are indicated where applicable. When you prepare data, this requirement may sometimes force you to create data values by some method (interpolation, copying from a previous hour or some sort of random generator).
- For CIR just indicate the value 0.
- DELDD is the change in wind direction from one hour to the next (based on wind direction for the previous, the current and the next hour). The unit is degrees. Assuming that *DD_after* is the wind direction during the hour after the current, and *DD_before* the wind direction during the previous hour, DelDD can be computed by this piece of code:

```
DIFF = DD_after - DD_before
IF (DIFF>180) DIFF = DIFF-360
IF (DIFF<-180) DIFF = 360+DIFF
DelDD = DIFF/2
```

- QUAL is a user-defined quality indicator for the data record. It is not used in calculations, so you may just indicate a value of 0 if you don't want to use it.
- FF is wind speed in m/s.
- HUM is humidity in %.
- NN is cloud cover in eights.
- RA indicates whether it has rained during the previous hour (0 for No rain, otherwise 1).
- SN indicates whether more than half of the ground is covered with snow (0 for no snow, otherwise 1).
- TC is temperature in Celsius.
- RAD is global radiation in W/m². Global radiation is incoming solar radiation, both directly from the sun and scattered by clouds. At night its value is 0, during daytime its value is positive. RAD may be missing. Indicate missing values as -99. In some contexts you may encounter the name "GL" instead of RAD.
- z0 is aerodynamic roughness height in meter (the term "roughness length" might also be used) in the area where the met data are obtained. Typical values are 0.03 m for short grass; 0.1 m for countryside with only few trees; 0.3 for suburban/urban areas. This parameter has a relatively small effect on results.

7.3.9 Output files with statistics

Output files from OML-Highway are divided into two groups: statistics and time series. For each run of OML-Highway seven files with statistics – referring to hourly concentration values – are produced. These are average values for the calculation period, the maximum of hourly values for the calculation period, etc. Further, a log file with the same name as the statistics is produced.

This section provides technical information on the files with statistics. The statistics can be visualized by using the button “View results” as explained in section 5.10.

The seven statistics files have a common first name, but bear different extensions to identify their content. The extensions are listed in Table 7.10. The statistics make most sense if you produce them for a one-year period; they refer to various EU air quality limit values.

Table 7.10. Overview of output files with statistics from OML-Highway.

Extension	Explanation of parameter
Mean	Averages ($\mu\text{g}/\text{m}^3$)
Max1hr	Maxima of hourly values ($\mu\text{g}/\text{m}^3$)
Max8hr	Maxima of 8 hour running mean conc. ($\mu\text{g}/\text{m}^3$)
H26D8hr	The 26th highest diurnal maximum of 8 hour running mean conc. ($\mu\text{g}/\text{m}^3$)
H19HrM	The 19th highest one hour mean conc. ($\mu\text{g}/\text{m}^3$)
H8DayM	The 8th highest 24-hour mean conc. ($\mu\text{g}/\text{m}^3$)
H36DayM	The 36th highest 24-hour mean conc. ($\mu\text{g}/\text{m}^3$)

Figure 7.9 shows a sample output file with extension “*.mean”. It has a one-line header, followed by a line for each receptor. The information in each record is coordinates, followed by mean concentration values for 9 substances. The substance names are self-explanatory, except possibly for PMExh (PM exhaust) and Pnumb (particle number concentration). Missing values are indicated by -999. The structure for files with other extensions is the same as the example shown.

Rec. No.	X	Y	NOx	NO2	O3	CO	CO2	PMExh	PM2.5	PM10	Pnumb
1	587559.06	6135302.50	2.462E+01	1.751E+01	3.986E+01	2.726E+02	-9.990E+02	4.275E-01	1.192E+01	2.121E+01	1.6492714E+09
2	587575.44	6135291.00	1.398E+01	1.133E+01	4.436E+01	2.613E+02	-9.990E+02	2.156E-01	1.145E+01	2.008E+01	6.4542598E+08
3	587550.88	6135308.50	1.751E+01	1.399E+01	4.223E+01	2.655E+02	-9.990E+02	2.872E-01	1.161E+01	2.047E+01	9.7504026E+08
4	587583.69	6135285.50	1.139E+01	9.857E+00	4.544E+01	2.589E+02	-9.990E+02	1.654E-01	1.135E+01	1.982E+01	3.9820634E+08
5	587542.63	6135314.00	1.515E+01	1.260E+01	4.326E+01	2.631E+02	-9.990E+02	2.406E-01	1.151E+01	2.023E+01	7.5102726E+08
6	587591.88	6135279.50	1.006E+01	9.006E+00	4.609E+01	2.578E+02	-9.990E+02	1.398E-01	1.129E+01	1.969E+01	2.7184077E+08
7	587534.44	6135319.50	1.380E+01	1.175E+01	4.391E+01	2.617E+02	-9.990E+02	2.139E-01	1.146E+01	2.009E+01	6.2233914E+08
8	587600.06	6135274.00	9.304E+00	8.481E+00	4.651E+01	2.571E+02	-9.990E+02	1.252E-01	1.126E+01	1.961E+01	1.9943322E+08
9	587679.44	6135673.00	2.227E+01	1.638E+01	4.060E+01	2.694E+02	-9.990E+02	3.777E-01	1.181E+01	2.095E+01	1.4165421E+09
10	587699.31	6135670.50	8.226E+00	7.625E+00	4.722E+01	2.560E+02	-9.990E+02	1.029E-01	1.122E+01	1.952E+01	8.0794096E+07
11	587669.50	6135674.00	1.767E+01	1.406E+01	4.219E+01	2.651E+02	-9.990E+02	2.881E-01	1.162E+01	2.048E+01	9.7798989E+08

Figure 7.9. The first lines of a file with output statistics. This file has extension “*.mean”, indicating that it contains average values for the calculation period.

7.3.10 Files of type *.out with a time series of calculated concentrations

Optionally, OML-Highway can produce a file with a time series of calculated concentrations. As a user you must specify which receptors should be included in the time series. This specification is given by an attribute in the receptor file: If the field RFTIMES is 1 (instead of 0) an hourly series of concentrations for that receptor is included in the *.out file. The attribute can be changed for individual receptors via the SELMA^{GIS} Digitizing menu, but it will often be more efficient to edit the attribute table manually.

Figure 7.10 displays an excerpt of the first lines of a file with a time series of concentrations for selected receptors. In example shown, receptor no. 13 and 14 have been selected. There may be more receptors included, but the excerpt only shows the parameters for receptor 13 and two (of nine) parameters for receptor 14.

The file has a two-line header. The first line indicates receptor number, and the second further identifies the columns beneath.

There is one record for each hour in the calculation period. The information in each record is date, hour in local time, hour in summer time (daylight saving time), and next concentration for 9 substances for each receptor. Missing values are indicated as -999.

You must use your own tools to process the information given in an “*.out” file.

Rec.:			13	13	13	13	13	13	13	13	13	14	14
Date	hrL	hrS	NOx	NO2	O3	CO	CO2	PMExh	PM2.5	PM10	Pnumb	NOx	NO2
20080101	1	1	3.18E+00	3.04E+00	5.38E+01	2.51E+02	-9.99E+02	1.67E-02	1.10E+01	1.91E+01	4.246395E+07	4.11E+00	3.70E+00
20080101	2	2	2.02E+00	1.95E+00	6.17E+01	2.51E+02	-9.99E+02	7.92E-03	1.10E+01	1.90E+01	2.011399E+07	2.41E+00	2.25E+00
20080101	3	3	1.07E+00	1.03E+00	6.35E+01	2.51E+02	-9.99E+02	5.89E-03	1.10E+01	1.90E+01	1.514240E+07	1.39E+00	1.27E+00
20080101	4	4	1.20E+00	1.15E+00	6.34E+01	2.50E+02	-9.99E+02	6.10E-03	1.10E+01	1.90E+01	1.310985E+07	1.53E+00	1.40E+00
20080101	5	5	2.32E+00	2.20E+00	6.07E+01	2.51E+02	-9.99E+02	9.75E-03	1.10E+01	1.90E+01	2.663931E+07	2.99E+00	2.63E+00
20080101	6	6	2.52E+00	2.39E+00	5.54E+01	2.51E+02	-9.99E+02	2.80E-02	1.11E+01	1.91E+01	7.162566E+07	4.95E+00	4.21E+00
20080101	7	7	5.12E+00	4.71E+00	5.15E+01	2.54E+02	-9.99E+02	6.94E-02	1.11E+01	1.93E+01	1.507755E+08	1.10E+01	8.87E+00
20080101	8	8	7.65E+00	6.99E+00	4.64E+01	2.59E+02	-9.99E+02	1.31E-01	1.13E+01	1.96E+01	2.652900E+08	1.54E+01	1.26E+01
20080101	9	9	9.76E+00	9.00E+00	4.60E+01	2.62E+02	-9.99E+02	1.50E-01	1.13E+01	1.97E+01	2.979616E+08	1.75E+01	1.47E+01
20080101	10	10	9.39E+00	8.24E+00	4.58E+01	2.58E+02	-9.99E+02	1.48E-01	1.13E+01	1.97E+01	3.062640E+08	1.65E+01	1.32E+01
20080101	11	11	8.94E+00	7.35E+00	4.66E+01	2.56E+02	-9.99E+02	1.26E-01	1.12E+01	1.95E+01	2.879345E+08	1.56E+01	1.17E+01
20080101	12	12	8.28E+00	6.89E+00	5.08E+01	2.58E+02	-9.99E+02	1.42E-01	1.13E+01	1.96E+01	2.826022E+08	1.47E+01	1.14E+01
20080101	13	13	8.73E+00	7.36E+00	5.00E+01	2.58E+02	-9.99E+02	1.37E-01	1.13E+01	1.96E+01	2.847968E+08	1.60E+01	1.24E+01
20080101	14	14	1.01E+01	8.54E+00	4.73E+01	2.60E+02	-9.99E+02	1.63E-01	1.13E+01	1.97E+01	3.240042E+08	1.76E+01	1.39E+01

Figure 7.10. An excerpt of the first lines of a file with a time series of concentrations for selected receptors. In this example, receptor no. 13 and 14 have been selected. Not all parameters referring to receptor no. 14 are included in the excerpt.

7.4 Configuration file SelmaGIS.ini

The configuration file SelmaGIS.ini is located in the folder, where OML-Highway is installed (C:\Apps\SelmaGIS for a standard installation).

You should be careful if you change the file, but advanced users may do so. SelmaGIS.ini is a text file, and contains headings for various sections.

7.4.1 Traffic Composition Categories

Settings for OML-Highway can be found under the heading [OML-Highway-Settings]. Here, e.g. the definition of classes for Traffic Composition Categories is given by the statements

```
HD_share_classes= 0 1 2 3 4 5 6 8 10 12 15 20 25 30 40 50 60 80 100
Speed_classes= 10 20 30 40 50 60 70 80 90 100 110 120 130
```

It is explained in Section 2.4 how these values are used for “binning” traffic composition into classes.

7.4.2 Background roads – traffic composition

Under the heading [UrbEmi] you find definitions related to background roads. The following 5 lines define aspects of traffic composition (cold start share and shares concerning types of heavy duty traffic) for the five types of background roads:

"Motorway",	0, 60, 30, 10
"Express way",	0, 60, 25, 15
"Road > 6 m",	5, 70, 15, 15
"Road 3- 6 m",	10, 70, 15, 15
"Other road",	20, 40, 0, 60

These five lines should be interpreted according to the following key:

Road type / Cold starts / "Truck_1" / "Truck_2" / "Buses"

to be understood in the following way when we consider the first line:

Road type: "Motorway"

Share of cold starts: 0%.

Share of trucks not heavier than 32 t: 60% of the heavy duty traffic.

Share of trucks heavier than 32 t: 30% of the heavy duty traffic.

Share of buses: 10% of the heavy duty traffic.

The sum of the three types of heavy duty traffic (Truck_1, Truck_2 and Buses) should be 100.

The shares of passenger cars and vans are specified elsewhere by the user, namely in the road network shapefile. Also the total share of heavy duty traffic (trucks + buses) is determined by the information in the road network shape file. The settings in Selmagis.ini solely determine the distribution among the three types of heavy duty traffic.

7.4.3 Size of grid for background emissions

By default cells in the grid for background emissions have a size of 1 km x 1 km. If you wish to change this, you must not only create such a grid in the GIS environment (Section 5.5.2), but also change the default value in the SelmaGIS.ini file.

Under the heading [OML-Highway-Settings] you will find the statement

```
BgGridSize=1000
```

which indicates the size of grid cells in meter.

7.5 Description of sample data

The OML-Highway software is accompanied by a set of sample files. You may receive the folder with sample files separately, not being part of the installation. In that case you should put it in a folder of your choice, which we will here refer to as the folder *TestData*.

TestData contains three subfolders: RoadNetwork, VariousOML_files and ExampleRun_001. The first two represent a sample of the data necessary to get a project started (RoadNetwork Shape and a few OML-Highway text

files as Background, Meteorology, deb file), while the third contains all files generated during an OML Highway based on the sample data.

The ArcMap project file for the sample project is \TestData\RoadNetwork\RoadNetWork_And_TargetRoads.mxd

Below is a listing of all files in the package (as of July 1, 2015; the contents of the package may be subject to change).

Directory of folder \TestData

23-06-2015 11:47	<DIR>	ExampleRun_001
23-06-2015 11:31	<DIR>	RoadNetwork
23-06-2015 13:19	<DIR>	VariousOML_files

Directory of \TestData\ExampleRun_001

23-06-2015 10:32	56,159	ARB_001.arb
23-06-2015 10:32	71,212	ARB_001.dbf
23-06-2015 10:32	148	ARB_001.log
23-06-2015 10:42	4,428	ARB_001.sbn
23-06-2015 10:42	612	ARB_001.sbx
23-06-2015 10:32	56,404	ARB_001.shp
23-06-2015 10:32	3,412	ARB_001.shx
23-06-2015 11:47	<DIR>	Export_001
23-06-2015 10:28	5	GRD_26_16.cpg
23-06-2015 10:28	4,642	GRD_26_16.dbf
23-06-2015 10:28	427	GRD_26_16.prj
23-06-2015 10:28	56,676	GRD_26_16.shp
23-06-2015 10:28	3,428	GRD_26_16.shx
23-06-2015 10:30	5	Intermediate_temp.cpg
23-06-2015 11:41	13,212	Jun2015_SELproj.sel
23-06-2015 10:30	864	KM_Travel_001.log
23-06-2015 10:30	315,392	KM_Travel_001.mdb
23-06-2015 10:37	4,171	Log_Synop_001.txt
23-06-2015 10:36	1,112,969	METfrom_Kastrup_Syn.met
23-06-2015 11:33	494,592	MXD_001.mxd
23-06-2015 11:35	239,616	MXD_001_ArcMap91.mxd
23-06-2015 10:46	34,634	ReceptorPoints_001.dbf
23-06-2015 10:33	1,624	ReceptorPoints_001.log
23-06-2015 10:34	427	ReceptorPoints_001.prj
23-06-2015 10:46	23,816	ReceptorPoints_001.rct
23-06-2015 10:46	3,364	ReceptorPoints_001.sbn
23-06-2015 10:46	324	ReceptorPoints_001.sbx
23-06-2015 10:46	14,356	ReceptorPoints_001.shp
23-06-2015 10:46	2,692	ReceptorPoints_001.shx
23-06-2015 10:34	256	ReceptorPoints_001.xml
23-06-2015 10:49	311,826	ResPNT_001.dbf
23-06-2015 10:49	1,349	ResPNT_001.log
23-06-2015 10:49	14,356	ResPNT_001.shp
23-06-2015 10:49	2,692	ResPNT_001.shx
23-06-2015 10:47	42,893	Statistics_001.H19HrM
23-06-2015 10:47	42,893	Statistics_001.H26D8hr
23-06-2015 10:47	42,893	Statistics_001.H36DayM
23-06-2015 10:47	42,893	Statistics_001.H8DayM
23-06-2015 10:47	163,105	Statistics_001.log
23-06-2015 10:47	42,893	Statistics_001.Max1hr

23-06-2015 10:47	42,893	Statistics_001.Max8hr
23-06-2015 10:47	42,893	Statistics_001.Mean
23-06-2015 10:10	96,977	Target_ART_001.art
23-06-2015 10:10	46,946	Target_ART_001.log
23-06-2015 10:10	2,276	Target_ART_001.xls
23-06-2015 10:14	354,034	Target_ART_001RSC.dbf
23-06-2015 10:14	79,981	Target_ART_001RSC.emi
22-06-2015 11:41	403	Target_ART_001RSC.prj
23-06-2015 10:14	105,364	Target_ART_001RSC.shp
23-06-2015 10:14	6,292	Target_ART_001RSC.shx
23-06-2015 10:13	180,232	Target_DET_001.det
23-06-2015 10:47	8,274	TimeSeries_001.out

Directory of \TestData\ExampleRun_001\Export_001

23-06-2015 10:32	56,159	ARB_001.arb
16-01-2009 17:46	63,711	BackgroundDiurnalEmissions.deb
08-02-2011 16:30	1,019,902	Meteorology.met
23-06-2015 10:50	651	OML-Highway.ini
23-06-2015 10:46	23,816	ReceptorPoints_001.rct
09-02-2011 01:05	632,792	RegionalBackgroundConc.dat
23-06-2015 10:10	96,977	Target_ART_001.art
23-06-2015 10:13	180,232	Target_DET_001.det

Directory of \TestData\RoadNetwork

22-06-2015 11:40	9,726,850	RoadNetWork.dbf
04-12-2013 23:01	403	RoadNetWork.prj
22-06-2015 11:40	271,412	RoadNetWork.sbn
22-06-2015 11:40	17,828	RoadNetWork.sbx
22-06-2015 11:40	4,112,540	RoadNetWork.shp
22-06-2015 11:28	64,653	RoadNetWork.shp.xml
22-06-2015 11:40	221,148	RoadNetWork.shx
23-06-2015 11:29	206,336	RoadNetWork_And_TargetRoads.mxd
22-06-2015 11:41	5	TargetRoadsOnly.cpg
23-06-2015 10:10	56,706	TargetRoadsOnly.dbf
22-06-2015 11:41	403	TargetRoadsOnly.prj
22-06-2015 11:41	1,692	TargetRoadsOnly.sbn
22-06-2015 11:41	220	TargetRoadsOnly.sbx
23-06-2015 10:10	32,076	TargetRoadsOnly.shp
22-06-2015 11:41	64,653	TargetRoadsOnly.shp.xml
23-06-2015 10:10	1,372	TargetRoadsOnly.shx

Directory of \TestData\VariousOML_files

16-01-2009 17:46	63,711	BackgroundDiurnalEmissions.deb
23-06-2015 13:20	946,616	Kastrup_2005_SynopticMet.txt
08-02-2011 16:30	1,019,902	Meteorology.met
08-01-2009 20:34	3,767	OtherBackgroundSources.aro
09-02-2011 01:05	632,792	RegionalBackgroundConc.dat

7.6 Definition of “day case”

“Day case” is a concept from OSPM and can be one of 8 cases as shown in

Table 7.11. It is used in the OSPM .trf files such as Type_A.trf (diurnal traffic variation files), where time variation for the various day cases is specified.

When working with *.trf files it is convenient to use the OSPM tool TrafEdit.

Table 7.11. Definition of “Day case”.

Day case	Description
1	Monday-Thursday; months other than July
2	Friday; months other than July
3	Saturday; months other than July
4	Sunday; July
5	Monday-Thursday; July
6	Friday; July
7	Saturday; July
8	Sunday; July

USER GUIDE TO OML-HIGHWAY

OML-Highway is a user-friendly GIS-based model for assessment of air quality along motorways and other main roads in open terrain. The user guide gives a brief introduction to OML-Highway and describes its use. It contains a detailed description of the various menus and their application. Further, it contains an appendix with reference material.

ISBN: 978-87-7156-150-0
ISSN: 2245-019X