SMHI

Airviro Specification

$$\frac{\partial c}{\partial t} + u\frac{\partial c}{\partial x} + v\frac{\partial c}{\partial y} + w\frac{\partial c}{\partial z} = \frac{1}{\rho}\frac{\partial}{\partial z}\left[\rho\left(K_z\frac{\partial c}{\partial z} + w_s c\right)\right] + \frac{Q}{\rho}$$

Airviro Specification v3.20

Part II: Appendices

SMHI

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Airviro Specification v3.20

Part II: Appendices

Amendments

Version	Date changed	Cause of change	Signature
2.3-2	020618	Changed paragraph E3.3	KH
3.0	040610	Changes to update to 3.0 functionallity	PI
3.11	060815	Update version 3.11	GS
3.20	100616	Update Dispersion	GS

Contents

Appendix D: System Data Files, Data Sets and Configuration Files

D1 Privileges

D1.1 User Privileges

A privilege database is used to control access to functions within Airviro. The access can be set up either per role or per user. A user can only belong to one role. Global privilege settings as well as settings per domain can be made.

Access to domains can be granted per role/user.

D1.1.1 EDB

Access to EDB can be granted per role/user.

The possibility to save macros can also be granted per role/user.

For usage of the global EDBs or personal EDBs belonging to a specific user, four privilege levels are available (user only):

- No access is allowed to any of the EDBs.

- EDBs can be viewed but no alterations may be made.

- EDBs may be viewed and altered.

- EDBs may be viewed and sources altered.

In addition another privilege set is available concerning the creation and deletion of EDBs which also has three levels:

- No EDBs may be created

- Personal EDBs may be created and deleted

- Personal EDBs may be created, all EDBs may be deleted including those belonging to other users.

D1.1.2 Indico Presentation

Access to the module can be granted per role/user.

The possibility to save macros can also be granted per role/user.

D1.1.3 Indico Administration

Access to the module can be granted per role/user.

The possibility to save macros can also be granted per role/user.

For the edit functions in the Indico Administration module (excluding editing of time series data), there are two privilege levels:

- Other roles/users may view the contents of the station and parameter databases, but may not edit them.

- The role/user may edit the station and parameter databases.

D1.1.4 Indico Report

Access to the module can be granted per role/user.

The possibility to save reports can also be granted per role/user.

D1.1.5 Indico Validation

Access to the module can be granted per role/user.

The possibility to edit or delete data can be granted per role/user.

D1.1.6 Dispersion

Access to the module can be granted per role/user.

The possibility to save macros can also be granted per role/user.

D1.1.7 Time series data

The possibility to add or modify time series data can be granted per role/user and station.

With rules it is possible to define exactly which time series a role/user can read or write.

D1.1.8 Map areas

The possibility to see and use a particular map area can be granted per role/user.

D1.2 Licence Manager

Airviro has been equipped with a licence manager which can limit which modules and features may be run, the number of modems and stations allowed and the length of time for which the software may be used. In order to be able to use Airviro, you must first obtain a licence codeword from SMHI.

The licence codeword is based on three strings obtained from the customer computer:

- The hardware identity. This is the internal identity of the computer.

- The L-string. This string is put together as a result of a series of questions about what may be carried out on the machine.

- The licence expiry date. This is the date until which airviro may be used.

This information is sent to SMHI who then generate a codeword.

The following modules may be turned on or off on the system and this information is incorporated into the L-string:

```
Airviro Main Menu
Indico Presentation
    Statistics
    Export
Indico Real Time
Dispersion
    Basic Scenario
    Basic Hour
    Canyon Model
    Gauss Model
    Heavy Gas Model
    Grid Model
        Scenario
    Grid Deposition Model
Receptor
    Receptor Model
Emission Database
      Grid Sources
    Report generator
Indico Administration
    Data Collection
        Time Series Database Editor
        Transaction Log
        Three Stage Database
    External Protocol Editor
Map Editor
```

The L-string also contains the maximum number of stations that may be created, and the maximum number of modems that the system may have configured.

D2 Files Used in Time Series Data Collection and Data Processing

D2.1 Automatic Calculation of Mean Values

Airviro can store time series data with different time resolutions. The program mean checks the keylist for new or changed records maintained by the database manager. Mean calculations to a lower time resolution are carried out where the necessary flags are set in the keylist and the mean values are spooled to the time series database. A resource file can

be used to modify the behaviour of mean. In this file the following constraints can be placed for the default action and also for individual channels:

- the minimum percentage of the total number of values required to create a mean value

- a distribution mask for sending of data to other airviro systems

- a mask denoting which statuses on values are allowed to be used in the mean calculation

- the flag to set in the keylist for further calculation of the data

- the status to give the new calculated value

D2.2 Standard Time Series Data File

A standard Airviro file format has been created for input and output of time series data. The standard file format looks like this:

```
SSSR D Comment
1 TPPPPNNN 1 F Comment
3 TPPPPNNN 2 F Comment
6 TPPPPNNN 3 F Comment
EOH
#Date , time, #1 , #2 , #3 , #4 , #5 , #6 , #7
YYMMDD, HHMM, 17, dum,  42, dum, dum, 4711, dum
EOF
```

#	All lines starting with a # are considered as comments and are ignored.
Comment	Comments may be put at the end of a line after data.
SSS	The station key that must be registered in the station database if you want the database manager to accept the spool file.
R	The time resolution if the database, usually * (daily values), + (hourly values) or , (minute values). (See Appendix C2.3 for a full list of time resolutions)
D	The distribution flag for data, in case you deliver this to other systems. Zero means no distribution.
column#	Indicates which column in the data chunk is being described, not counting the date and time columns. The columns do not have to be described in order.
T	Indicates what kind of data is to be dealt with and therefore how many parts each data consists of. For example ÔO' indicates OPSIS data with value, standard deviation and light intensity. See Appendix C2.3 for a full list of data types with an explanation of the different associated values.
PPPP	The measured parameter key. Must be registered in the parameter database for the database manager to accept them.
NNN	Data instance that makes the measured value unique for this station, since the same parameter might be measured in different directions or on different levels. Usually three digits indicating metres above ground level or path number for OPSIS.
value#	Indicates which part of the value (see T above) this columns value uses. Note that if you have indicated that this is an OPSIS value, you have to describe all three parts for this key or the data will be considered missing. Also note that part 1 and 2 are floating point

	values but part 3 is an integer between 0 and 127. All kinds of values also have a status flag that is in the range 0 - 15 - status is automatically set to 1 if the value exists and otherwise to 0. If you wish to set the status value explicitly, you could address it with value# set to zero.
F	Indicates what flags to set in the keylist (for mean value calculations etc.). A zero means no flags are set.
EOH	End Of Header - indicates that the description of the data chunk is done and that the data follows.
YYMMDD, HHMM	Year, month, day, hour and minute of the data in the current line.
values	The first data after the date and time is referenced as column 1. Data is referenced by the column it appears in and not the position on the line so the commas separating the data are very important. If a value is missing it is best indicated with just white space between the commas.
EOF	Indicates the end of the data chunk.

D2.2.1 Example

```
ZK0+ 0             # Station ZK0, hour resolution. No distribution
1 MWSPD002 1 0  # Col 1, Met, Wind speed, 2m, data 1, no key
2 MWDIR002 1 0  # Col 2, Met, Wind direction, 2m, data 1, no key
5 K0001003 1 0  # Col 5, Chem, SO2, 3m, data 1, no key
3 K0001003 2 0  # Col 3, Chem, SO2, 3m, data 2, no key
EOH
# Start of data
910228, 0100,  1.1, 1.2, 1.3, 1.4 ,     , # Missing column 5
910228, 0200,  2.1,    , 2.3, 2.4 , 2.5  # Missing column 2
# Time jump
910228, 0400,  3.1, 3.2, 3.3, 3.4, 3.5
# Another time jump
910228, 0700,  4.1, 4.2, 4.3, 4.4, 4.5, 5.5
# No more data
EOF
```

Everything after EOF is ignored.

D2.3 Data Import Interface

For customers who frequently need to manually import data where the format is always the same, there is an Import interface. By default, the standard import format is a straightforward comma separated file, just like example D2.2.1 but without the first few header rows.

Within the import interface the user specifies the station to import to, and the location of the file containing the import data. Details of the parameters to which the data are to be imported are specified in the Import protocol in the External Protocol Editor.

D2.4 External Protocol Configuration File (xpr file)

The external protocol configuration file is a text file format created for handling arbitrary information about external protocols used for data collection. The xprfile consists of three kinds of lines: **comments**, **data** and **format information** (used when editing). Note that

lines ending with a backslash (\) are concatenated with the following line and the sequence backslash n (\n) will be replaced by a new line.

Comments begin with a hashmark (#). These lines are ignored by everything but the external protocol editor. The editor really doesn't care either, but the comments will still be there after the file has been edited.

The specific **data lines** start with a three letter station key separated by a point (.) from an entry name which in turn is separated from the value by a colon (:). Leading white space in the value is ignored. An example of a specific data line is:

SA1.phone: 08222000

format information lines look just like the data lines, but start with either help, type, name or template.

If there is a help line for an entry, this will be shown in the help row at the bottom of the external protocol editor when this kind of entry is selected.

If there is a type line for an entry, this kind of entry is possible to edit and the result will be checked according to the value. The currently supported values are: 1 for any string, 2 for a phone number, 3 for an integer, 4 for a standard header and 6 for a complex value which has further restrictions. In the future these will increase and there will probably be restriction arguments to some of them.

If there is a name line for an entry, this name will be shown instead of the entry itself in the editor. This makes it possible to change what the user sees without having to change the programs that use the file for retrieving information. With carefully selected names, the user is given the information in a good logical order. This can for instance be accomplished by putting a numbering at the beginning of the important entries and then having a proper name entry on top of it.

Note that there is a special name entry for the protocol itself, that may contain additional information about the protocol itself. For instance, the a30 protocol may have an entry like this:

name.a30: Philips A30 software for PC

All template lines will be used when creating a new station, unless and existing station is used.

Other lines not matching any of the formats described above are currently ignored, but the problem is noted to the error daemon.

D2.4.1 Example of an External Protocol Configuration File

```
template.0smartswitch:  0 # No switch present
template.0phone:        XXXXXXXX
template.0id:           XX
template.1header:       XXX+ 0 # Station, resolution and custflag
template.2data.01:      1 M0003001 1 0 0 0 0 # Col 5 is gas 3
#
# This is how each entry should be handled:
type.0smartswitch: 3    # Integer
```

```
type.0phone:       2    # Phone number - has set of good characters
type.0id:          1    # String of any kind
type.1header:      4    # Standard header format
type.2data: 6[11110001] # Complex editor without chanuse, min, max
#
# Help information shown when selected
help.0smartswitch: The switchboard number or 0 if direct.
help.0phone: Only what a Hayes modem understands, please
help.0id: The two letter id.
help.0height: Measuring level in metres.
help.1header: The station and resolution to store data under.
help.2data: Column, key, attribute, key flag actions and comment.
#
# Cleaner names - The first one is for the title
name.a30: Philips A30 software for PC
name.0smartswitch: Switchboard
name.0phone: Phone number
name.0id: Identity
name.0height: Height
name.1header: Header
name.2data: Data
#
# This is an entry for SA1
SA1.0smartswitch: 1
SA1.0phone: 08875268
SA1.0id: KA
SA1.1header: SA1+ 0                     # Hornsgatan
SA1.2data.01: 3 M0003002 1 0 0 0 0 # NO2 at Hornsg 108
SA1.2data.02: 4 M0004002 1 0 0 0 0 # CO  at Hornsg 108
```

D3 Data Required for System Preparation for Dispersion Calculations

D3.1 Introduction

In order to commission an Airviro system for a given geographical area, necessary data must be acquired, processed and loaded into the system. The required data are described in this section, together with acceptable data formats. The data should be provided in a storage format commonly available on UNIX workstations, for example in tar format on DDS-tape, or in DOS-format on floppy discs. The data may be compressed using for example zoo or lha.

D3.2 Necessary Geographical Information for Airviro

D3.2.1 Background

Airviro makes use of geographical information or maps as backgrounds for the display of different types of information, such as ambient air concentrations of a pollutant. The presentation of such "fields" is in the form of isolines or illustrated as coloured grid boxes (see Figure D3.2.i: and Figure D3.2.ii:). For modelling purposes, Airviro also needs information about the topography and surface roughness of the area.
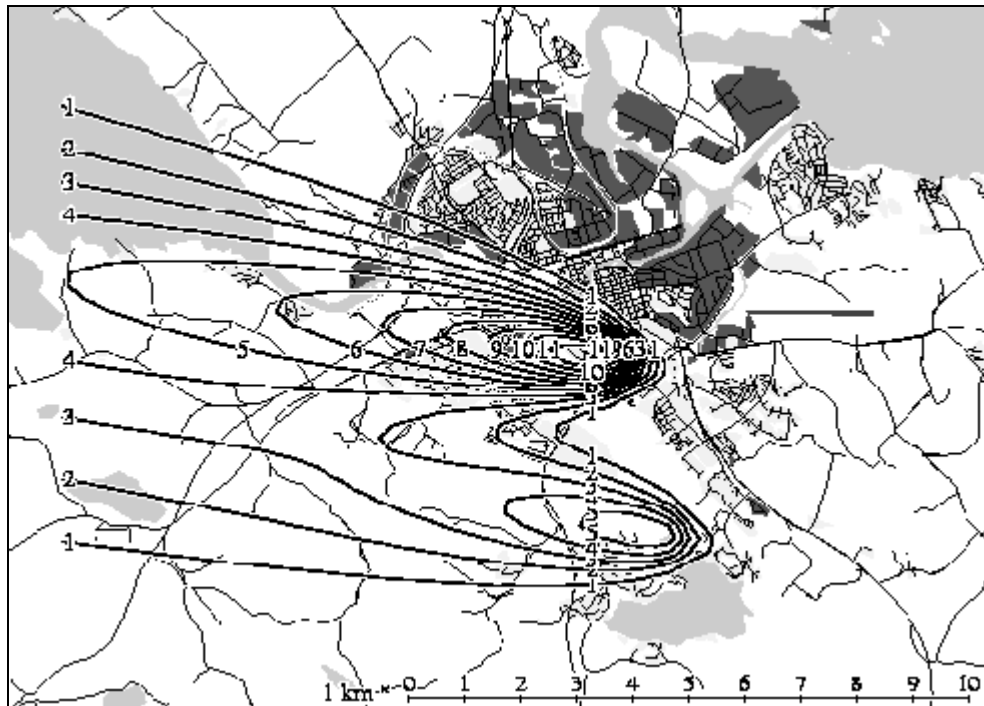
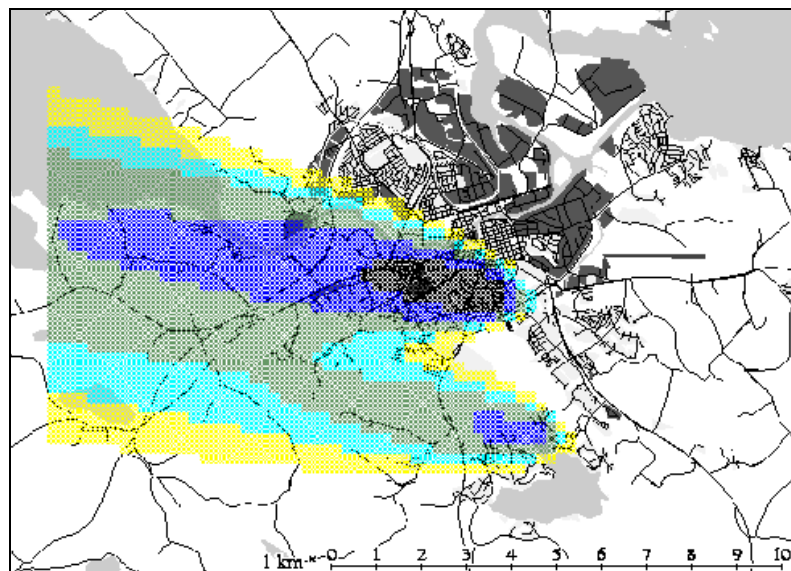*Figure D3.2.i: Presentation of ambient air concentrations of pollutions as isolines.*

Figure D3.2.ii: Presentation of ambient air concentrations of pollutions as coloured grid boxes.

Digitised Vectors and Coordinate Systems

The geographical maps are imported into the system in the form of digitised vector chains. Each object that is to be shown on the map, for example a lake, an urban area, a forest area, a highway or a river, is defined as a chain of (x, y)-coordinates (x_1, y_1), (x_2, y_2), ... (x_n, y_n). These coordinates must refer to a reference system for the area, that is an orthogonal Cartesian coordinate system. Usually, such a system gives the coordinates in metres. A number of different systems for map projection exist - one widely used, internationally well known, Cartesian system is the UTM-system. If the y-coordinate does not coincide with the geographical north, this must be specified separately (usually the UTM system has a maximum deviation in the order of 1°).

D3.2.2 Specification

The digitised information to be provided for Airviro must describe (as a minimum) the following types of objects:

- Sea and lakes (coast-lines).

- Land areas separated into open fields, forests and urban/sub-urban areas.

- Line-objects, for example roads, railways, rivers etc.

Objects that consist of areas that are supposed to be filled with a colour (such as lakes) MUST be 100% closed polygons. The first coordinate pair (x_1, y_1) must be identical to the last pair of coordinates, i.e.

$x_1 = x_n$, $y_1 = y_n$.

The types described here are also used to determine the roughness of the area, later to be used as boundary conditions for various dispersion models in the system.

Sea and Lake Objects

Suppose that you are about to paint a picture, that contains an island which has a small lake. First you paint the whole canvas blue, then on top of the blue you apply maybe green to symbolise the island. Finally, you paint the small lake in blue on top of the green.

The procedure to make maps for an Airviro system is very much the same. Each type of object must be given separately. Within one type, different levels or resolutions must be given separately, for example an island with a lake, which itself contains island and on that island is a small lake etc. Each level must be given in a separate file:

1. Coastlines for all islands in the sea and the coastlines for the mainland are given in one file.

2. All lakes on any of these islands or on the mainland are given in one, separate file (first level of lakes).

3. All islands in "first level of lakes" are given in another, separate file

Each object that the user wants to see on the screen must be described by digitised vectors.

Different Land Areas

Airviro makes use of a classification of surface roughness in accordance to different classes of land use. These are:

- Urban areas

- Open fields

- Forests

- Sea or lakes

As a minimum, the digitisation must describe these different types of land use. Usually this information is available from the original, printed maps. Bear in mind the discussion about lakes and islands for the different levels of objects.

Suitable Map Resolution

A scale of 1: 50000 is usually quite appropriate. When looking at the degree of detail in the final appearance on the screen, this scale gives vectors with a satisfactory resolution. With this scale an area of approximately 1500 km^2 should not produce ASCII-files of vectors that exceed 10 Mb of information and SMHI recommends this size of map. Maps larger than 10 Mb will be slower to work with.

When presented on the screen, the degree of zooming determines the degree of map detail. If the vectors have too much detail for the presentation, they are automatically smoothed out. When zooming, more and more details appear according to the resolution of the screen. The upper limit of resolution (when zooming) is however determined by the degree of resolution of details in the original digitisation.

The system can be configured to show one specific level of resolution first at a certain degree of zooming. As an example, the overview may show just major roads, while a zoomed up picture also contain small roads and paths.

Text Strings

For the sake of orientation, text strings can be superimposed on the map. The strings appear with the same font size, regardless of the degree of zooming. The text strings should be given together with an (x, y)-coordinate, indicating the lower centre of the string position on the map. Different levels of strings can be presented at different levels of zooming.

D3.2.3 Urban Areas

For urban areas, different approaches may be used (see Figure D3.2.iii:). The area can be described by the outer contour of a village. In this case the whole village will appear as a (red) coloured blot on the map. The blot can contain some roads or streets that will be superimposed over the blot.

Another way of describing an urban area is to resolve each block. In this case, each block appears on the map as (red) coloured areas, and the space in between two blocks retains the

background colour. Whatever method selected, bear in mind that it should be possible for the user to orientate himself.
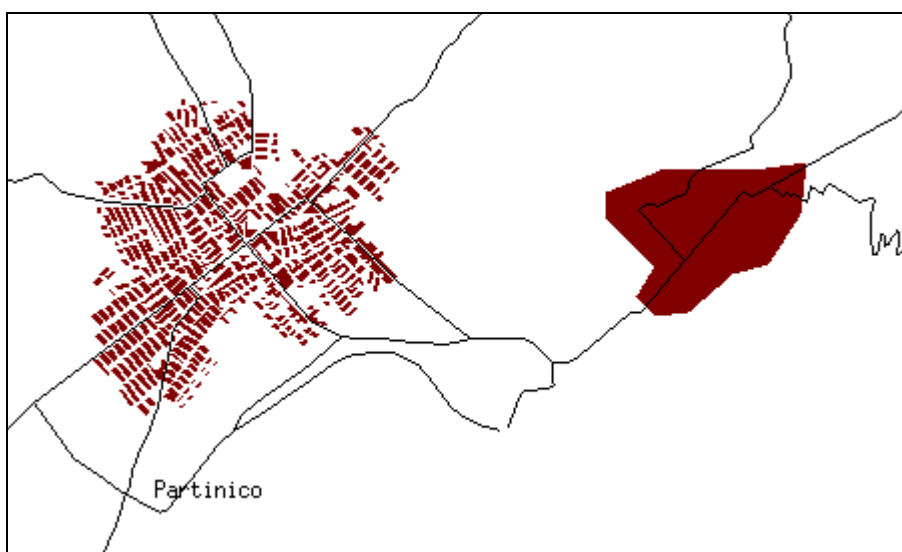
Figure D3.2.iii: Different "designs" for urban areas

D3.2.4 Topographical Information

In many geographical information systems (GIS), topographical information for an area is available. Airviro makes use of digitised topographical information acquired as follows:

1.   grid net is defined over the area (see figure D3.2.iv). A common resolution of this grid net is 500 x 500 m.

2.   Within each grid box, the mean height Z above sea level is determined.

The heights are given in an ASCII file together with the lower left corner coordinate for each gridbox: (x1, y1, Z1)
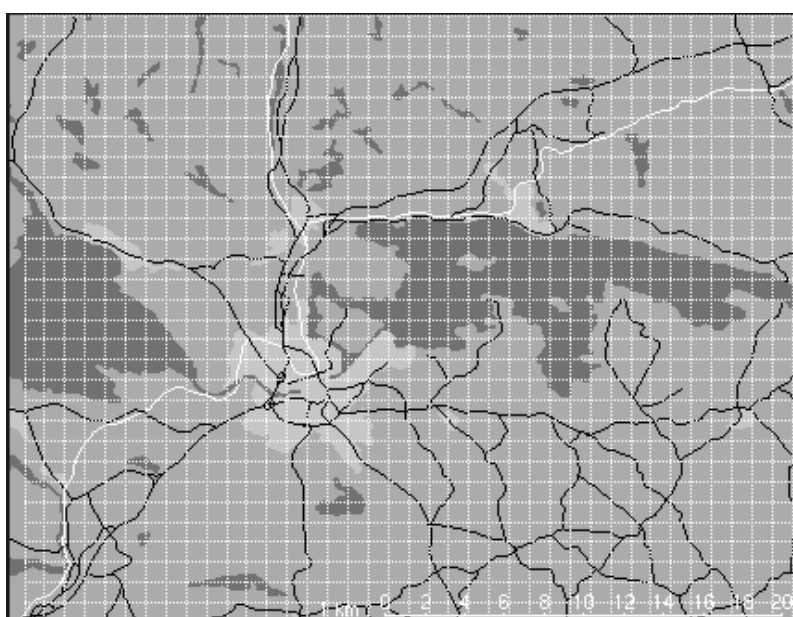
Figure D3.2.iv: An example of the grid representation over the area.

If no topographical information in digitised form is available, SMHI requires that printed topographical maps be sent to SMHI's office for manual processing.

D3.2.5 Approved File Formats

The map information (vectorised maps, text strings and digitised topographical information) should be sent to SMHI in the following formats (readable ASCII):

```
#  Vectors:          x1, y1
                     x2, y2
                     x3, y3
                     x4, y4

#  Text strings:     x1, y1, "string1"
                     x2, y2, "string2"
                     x3, y3, "string3"
                     x4, y4, "string4"

#  Topography:       x1, y1, Z1
                     x2, y2, Z2
                     x3, y3, Z3
                     x4, y4, Z4
```

For the topography section, xn and yn are the coordinates of the bottom left corner of grid squares in a 250 m grid superimposed on the map.

Each type of object must be found in a file, identified by a unique name. Each file should be stored on a PC diskette or on a HP-DDS tape.

The file formats should be one of the following:

- DXF (AutoCad, Intergraph)

- Ungenerate (ArcInfo)

- Ordnance Survey (NTF format)

D3.3 Physiographic Data

Airviro uses physiographic data to deduce the lower boundary conditions for the wind field model and for the dispersion models. The lower boundary condition can be looked upon as a description of that surface (or those qualities) that the model atmosphere will recognise at the earth's surface. This information is fairly constant in time and the qualities of interest are height above sea level and type of surface (e.g. sea, forest, urban, etc.).

The models used by Airviro have a finite resolution or grid representation of all quantities calculated. In the same manner, the models must be provided with boundary conditions with the same grid representation. This implies that the qualities mentioned above should be provided as averages within each grid cell.

The information that has to be available within Airviro in order to deduce the grid representation of the lower boundary conditions is:

- Mean height above sea level within each grid cell.

- The fraction (by area) of sea (water surface), open fields, forest and urban areas within a grid cell.

- The mean building height within a grid cell.

The size of the grid cells that should be used for extracting physiographic data should be 250 by 250 metres. If the information is going to be used in the models in another resolution, the final, deduced parameters will be transformed (interpolated) from this 250-metre resolution.

From the primary physiographic data, the model boundary condition parameters are deduced. They are:

- **Mean height above sea level** (same as the primary data)

- **Roughness parameter z0**. This parameter can be regarded as a description of the coarseness of the surface. The bigger (in an average meaning) the obstacles that are found on the ground, the bigger the z0. In fluid dynamic theory, z0 is defined as that height above a surface where the flow (or the wind) ceases. z0 ranges from a few mm or cm for cut grass to 1 m for an urban area.

- Each grid cell should be classified with an **influence type** (see appendix E3.1.5). The different types of influences are given in a resource file. Within each class the meteorological conditions are considered similar. The default values give a uniform type for the whole area, which means that interpolations of a grid point only depend upon the distance from the observation stations.

- If buildings are high and dense then they could generate a **heat island effect**, that is a higher temperature and thus a different stability. Each grid cell should be classified with the value 1 if the heat island effect is present and 0 if it is not. The default value is that no heat island effect is present.

D3.4 Necessary Weather Information for Airviro

D3.4.1 Describing the Weather

Most of the applications in the Airviro system are linked to a geographical map. In the emission database all emitters of air pollution are described as point, area or line references on the map with an accuracy of 1 m. When estimating the dispersion of the pollutants we need to know not only the emissions but also the weather characteristics over the geographical area.

This section describes methods for estimating the important weather parameters, in the vertical as well as in the horizontal direction. We will not be able to describe the important weather variation as precisely as for the emission sources, as the resolution in the horizontal dimension is 250-500 m and in the vertical between 1m and 50-100 m depending on the complexity of the weather situation and the level above ground. The accuracy is also dependent upon the type, quality and number of measuring stations located in the area. Obviously the accuracy of the dispersion calculation is based on the quality of

meteorological input data, a fact that should be taken into account when considering investments in software and hardware.

It is very common that air quality monitoring networks consist of one or several weather stations based on a (low quality) wind monitor and a temperature sensor located at the same place as the air quality monitoring equipment. In many cases, the location, choice and the quality of the weather sensors are not ideal for the dispersion calculations. For example, wind monitors are often situated on top of buildings in a city. The influence of the nearby buildings is so dominant that the only meaningful information (to be used for other parts of the city) given by the sensors is a very crude measure of wind direction and speed on an hourly basis. If the quality of the weather information in the existing air quality network is to be of the same quality as the air quality measurements, then the meteorological measurements should be based on the principles described below.

D3.4.2 Vertical Condition of Meteorological Parameters

When estimating the dispersion of pollutants it is necessary to know the weather characteristics over the area of interest. The most significant weather information is the wind, the turbulence situation (vertical mixing) and the temperature. To be able to execute the dispersion models we need to know the wind and turbulence condition not only at ground level, but in a layer from the surface up to the level at which the wind and turbulence is no longer affected by the ground. This level is usually called the *mixing height*.

The layer between the ground and the mixing height is usually called the *mixing layer*. Sometimes the mixing height is not more than 30-40 m above ground level (inversion situations in clear sky conditions and weak winds during nighttime), in other situations the mixing height can be 4-5000 m (sunny days).

If the mixing height changes from 200 m to 100 m and the emissions remain constant, the air pollution concentrations in the air are likely to increase by 100%. The same amount of pollutants is to be distributed over a volume that is half the initial size.

D3.4.3 Mixing height Depends on Wind Speed and the Vertical Temperature Profile

As indicated above, the mixing height is dependent upon the turbulence and the winds. If we measure a weak wind at the surface during a winter night with a clear sky, it is likely that we have a low mixing height (figure D3.4.i a). If we measure strong winds at ground level, it is likely that we have favourable turbulence conditions and the mixing layer is deep (figure D3.4.i b).

During day time, we can measure weak winds but still have good mixing and a deep mixing layer. This would be the case if there is strong heating of the ground (due to solar radiation), which affects the air temperature close to the earth's surface. The heated air has a lighter density than the air above, an instable situation, creating a vertical motion (a thermally induced turbulence) that could penetrate several kilometres up in the atmosphere (figure D3.4.i c).

Therefore, there is an obvious reason to measure wind profiles as well as temperature profiles close to the ground. The turbulence conditions are mostly generated by fluxes of temperature from the earth surface or friction that generates mechanical wind turbulence.
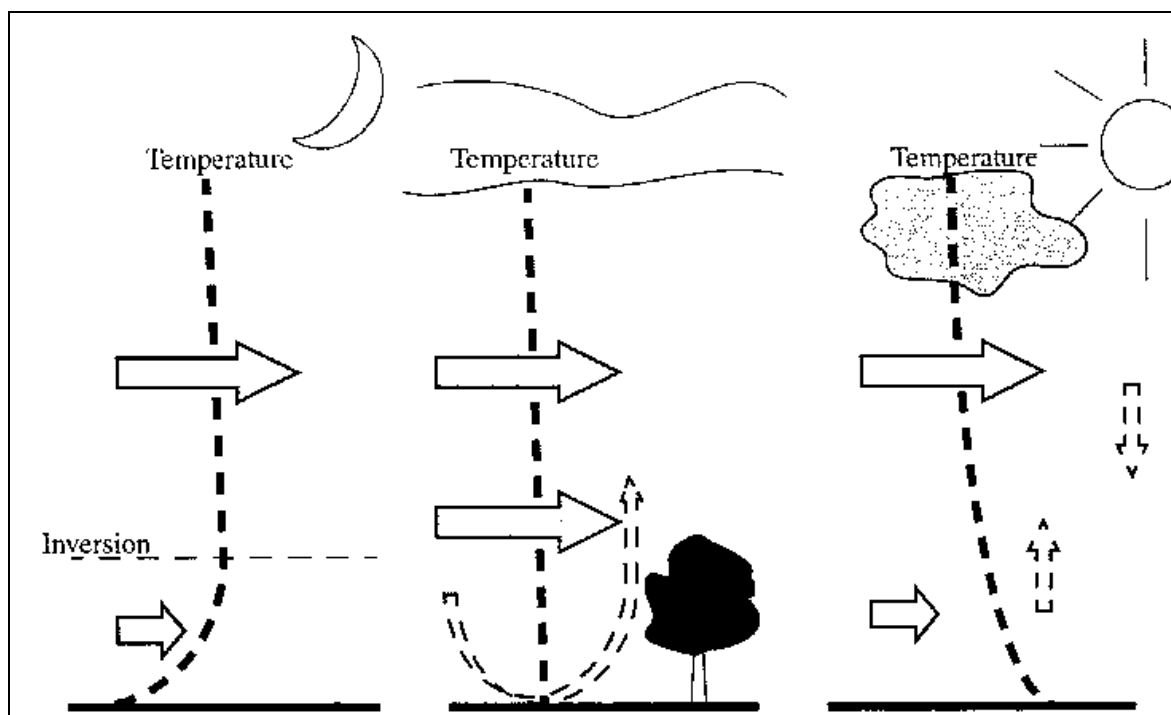
Figure D3.4.i: *a)*   *b)*   *c)*

D3.4.4 Estimating the Mixing Height, Turbulence etc. in the Airviro System

As indicated above, measurements of the wind and temperature profiles can be used to estimate the mixing height and turbulence parameters which are required for dispersion calculations. If it were possible to measure temperature and (especially) winds up to several hundreds of meters above ground, then we would have a very good knowledge of the atmospheric conditions. However, there are technical as well as economical barriers that prevent us from doing so. If we have limited economical resources, a good solution to our problem is to find an existing mast and install meteorological sensors.

D3.4.5 Measuring Requirements

A good solution to our problem is to find an existing mast and install meteorological sensors. In Göteborg an existing mast 100 m high is equipped with temperature and wind sensors. This is an acceptable solution that provides high quality input data.

In many areas a 100 m mast will not be available. In this case SMHI recommends a standard solution, i.e. a 24 (25 including wind sensor) metre high mast.

An Airviro principal mast is equipped with three temperature sensors at 22m, 8m and 2m, measuring the temperature differences. The normal vertical temperature difference in the atmosphere is approximately 0.07°C per 10m, indicating that these sensors need to be accurate. At the top of the mast (25m), SMHI recommends a sonic wind anemometer, capable of detecting 3-dimensional winds. At 10 m an ordinary horizontal wind anemometer is suggested. At 2 m an absolute temperature sensor as well as a global radiation sensor (measuring direct radiation from the sun as well as diffusive light) should be installed.

As an option a precipitation sensor (yes/no and amount) is recommended. In certain locations (often foggy conditions) a humidity sensor should be installed.

Parameter	Requirements	Time resolution
Horizontal wind (speed and direction)	Threshold < 0.25 m/s Accuracy better than 0.3%	15 minute mean value and standard deviation based 0.3% on sensor output frequency 1 Hz
Vertical wind	Threshold $\cong$ 0 Accuracy better than 3%	15 minute standard deviation based on sensor output frequency 1 Hz
Temperature	Accuracy better than ± 0.1 °C	Mean value over 15 minutes
Temperature difference*	Accuracy better than ± 0.03 °C	Mean value over 15 minutes

*Temperature difference must be measured in a radiation shield ventilated at a constant speed of approximately 3m/s

D3.4.6 Proposed Measurement Equipment

SMHI suggests that the following type of sensors should be used:

Parameter	Sensor type and configuration
Horizontal wind	A propeller anemometer of "Air Quality" approved type (according to the US EPA).
Horizontal and vertical wind at the top of the mast	A three axis ultra sonic anemometer.
Temperature	Platinum sensor PT-100 in a traditional radiation shield or fan aspirated radiation shield.
Temperature difference	A bridge configuration of thermo-couples for direct measurement of temperature difference, mounted in fan aspirated radiation shields.
Precipitation	A traditional tipping bucket sensor
Global radiation	A pyranemometer based on a photo diode with a spectral response similar to the visual light.

Capturing of data and primary signal processing (pre-processing) are to be carried out at the mast. These procedures also include automatic sensor quality control and alarm in case of malfunction. A certain amount of data (at least one week) should be stored locally.

The acquisition unit must be robust and protected against thunder and lightning. The unit must also be able to communicate via the public telephone network (or direct line) with the central computer and allow remote monitoring of the meteorological installation.

D3.4.7 Weather Data Processing in Airviro

The mast data is collected by Airviro and stored in the time series database. These data are processed in the pre-processor (see the figure in chapter 4 of Part I) in the following way
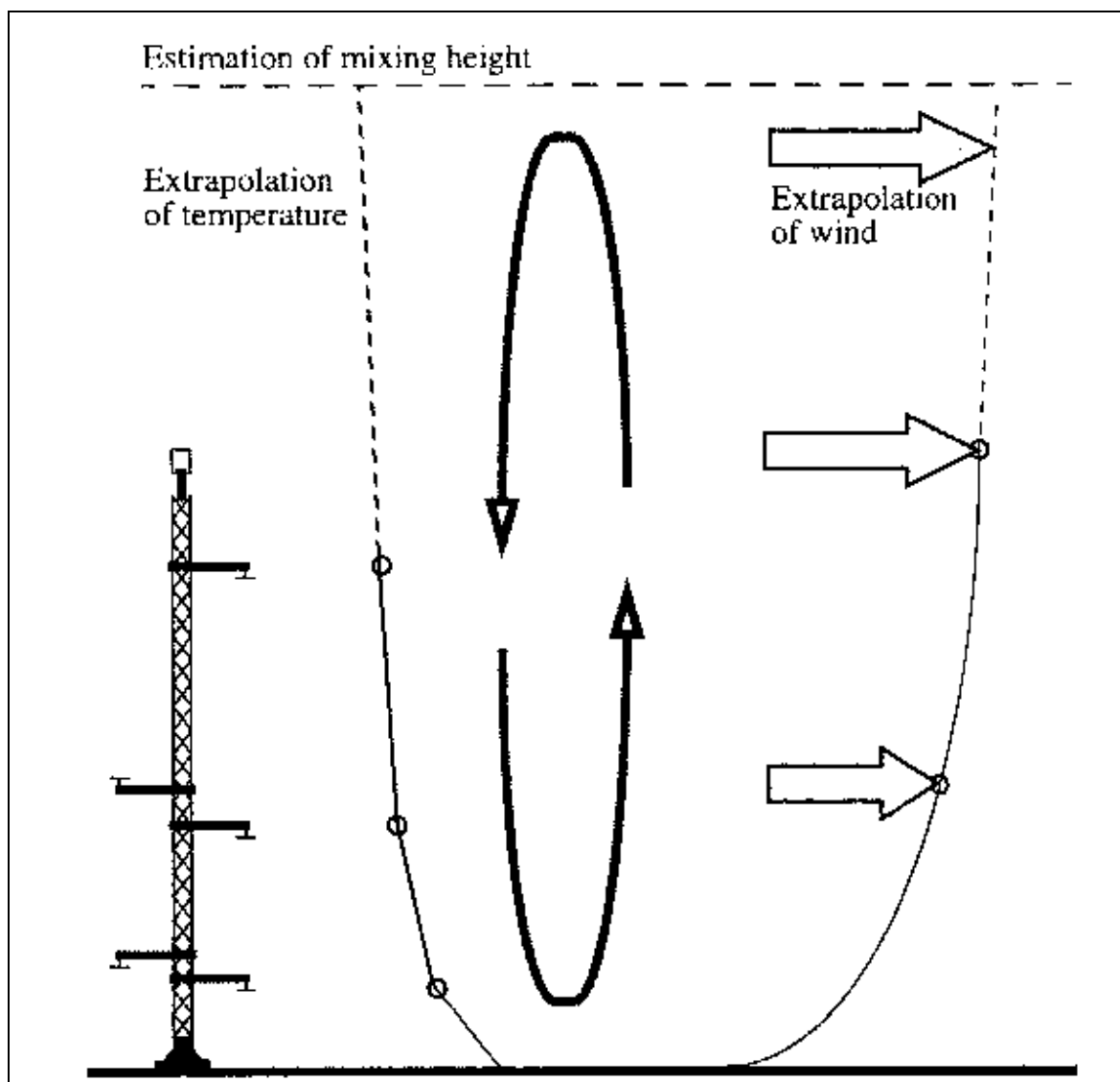
Figure D3.4.ii:

The measurements of wind and temperature from the mast are processed with a profile method to determine the so-called Monin-Obukhov length (L). An analytical function describing the vertical temperature and wind is established as a function of the roughness of the ground, the height above ground and the Monin-Obukhov length (L). This curve can be extrapolated above the highest measurement site in the mast and an estimation of the mixing height is given. An estimation of the wind (speed and direction) at the level of mixing height is performed. This is a wind that is usually denoted the free wind (not affected by ground) (see *Appendix E3* "Models Available for Use With the Dispersion Module").

D3.4.8 Extrapolated and Modelled Weather Conditions at Other Sites Within an Area

If the geographical area is not too large and complicated, it is possible to extrapolate the weather information measured at the site where the mast is located to all other locations in the area.

Concerning winds, it is important to notice that it will never be possible to estimate all microscale winds that occur instantaneously in the canopies of the forests, close to buildings, etc. It is possible, however to estimate the 15-minute mean wind as an areal average, if the areas are assumed to be of the order 250*250 m in the horizontal direction. In cities and forests the winds are estimated above the buildings or the top of the trees.

Small uniform areas: If the area is small (approx. 10*10 km) and uniform, that is it does not have a complex topography, or includes coastal regions and large urban areas, then one meteorological mast (24 m) is sufficient as input data for describing the weather in the area. The mast should be located at a representative position, avoiding conditions that would create unique microscale weather characteristics. By using the methods described earlier, the *mixing height* as well as the *free wind* can be assumed to be valid for the whole area. The stability parameters together with information about the surface roughness and topography can then be used to estimate the response to the free wind at all other locations in the area.

This interpolation procedure is performed with the dynamic wind model described in *section E3.1* "The Wind Model - Calculation of the Wind Fields".
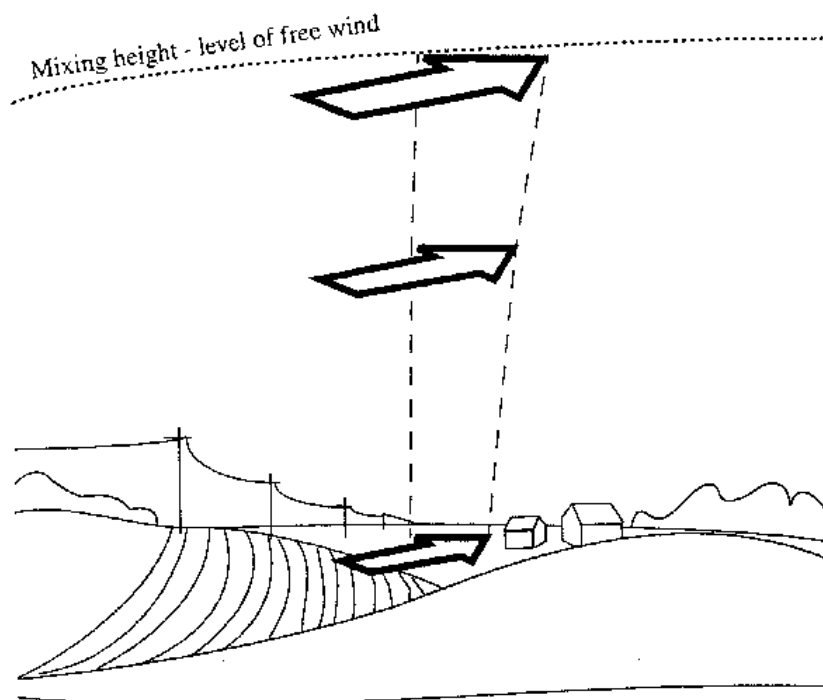
Figure D3.4.iii:

In figure D3.2.iii the vertical profiles of temperature and wind have been measured at a location several kilometres away. It is assumed that the free wind is constant over the whole geographical area and that stability parameters are also the same. From these assumptions we will be able to determine the vertical wind profile at the location above, by introducing the frictional and topographical forcing from below. Information about topography and characteristics of the terrain at this location need to be available within Airviro, and utilising this information we will be able to compute the balance between friction and the "pushing" of the winds from above and from beside.

Small or medium size complex areas: If the area is complex then some additional measurements (and computations) are necessary to be able to describe the weather in the whole area. The different approaches are:

Land/sea conditions	If there is a large lake included in the area or if the area includes a coastal region, the local circulation systems can develop as a consequence of the difference in temperature between land and sea surface. To be able to diagnose the winds created in this way the wind (10 m) and absolute temperature (2m) should be measured at least at one location at the border between sea/land.
Urban conditions	If there is a pronounced urban area included in the region, with concentrated large buildings, then it is likely that internal dispersion conditions will occur in the city, due to the pronounced heating from traffic, buildings, and radiation conditions. In this case it is advisable to supplement the existing meteorological mast with measurements of absolute temperature (2m) at location(s) in the centre of the city.
Complex topography	If the area consists of one or several dominant valleys, then the winds in the valleys will be channelled by the topography, affected by the heating of the slopes due to solar radiation as well as affected by the cooling in the valleys. As a minimum at least one wind (10m) and temperature (2m) station in each valley is needed in addition to the 24 m met mast.

Large areas: As soon as areas of typically 100*100 km are worked with, it is most likely that the area consists of one or several urban areas, large lakes or coastal regions or regions of complex topography. Consequently it is likely that more than one weather measurement station will be required. If the terrain in the area is homogenous and flat, there are other reasons for installing more than one measurement station. On this scale, it is likely that the large-scale weather situation is different over the area. Consequently, it is not possible to measure at one location, estimate the free wind and assume that it should remain constant over the area. As a rule of thumb, 1 weather mast is needed in each subarea of 40*40 km.

D3.4.9 Dispersion Models to be Recommended

In the Airviro system, two different dispersion models are available; the Lagrangean/Gaussian model and the Grid model. In many cases the Lagrangean/Gaussian model can be used but in other cases it will not produce relevant information.

The Grid model is much more complex and should only be recommended if necessary, i.e. when the following conditions are to be met:

- the area size is larger than approximately 30*30 km.
- the topography of the area is complex.
- episodes of air pollution occur due to accumulation of pollutants.
- deposition of pollutants is to be calculated.

The grid model is based on the solution of a set of nonlinear partial differential equations (described in *section E3.3* "The Grid Model".*)* This model demands much more computer capacity than the Gaussian model and the quality of input data is crucial for the success of simulations.

D3.4.10 Climatology Data for Long Term Scenario Calculations

The Gauss, Grid and Street Canyon models can use climatologies to produce averages and 95th-99th percentiles for different scenarios. The climatology consists of a list of hourly events, each of them with a certain frequency of occurrence, which together will yield a distribution of different weather conditions that is similar to the distribution of the full scenario period. Data from a principal meteorological mast (see *section E3.1.1* "Principles of Wind Field Calculations") must be available for all hourly events referenced in the scenario climatology.

The climatologies for different scenarios are configured on delivery of an Airviro system, where the scenarios are defined in advance by the customer (normally to comply with the way national standards are specified). Typical scenarios are winter and summer seasons.

The configuration allows the following specification of the scenario climatologies:

- number of direction classes (wind sectors)

- number of stability classes within each direction class (maximum 10)

- time period within the time series database for which the scenario climatology should be calculated

- identification of the principal meteorological mast that should be used as a basis for the climatology

Typical sizes for a seasonal scenario are 60 wind direction classes with 6 stability classes within each wind sector, making a total of 360 hourly events.

A maximum of 20 different scenarios is allowed.

The scenario climatology for the Grid model is basically the same as for the Gauss and Street Canyon models, but has the extra feature that it may contain sequences of hourly events, where some of the initial hours will only be used to build up a realistic concentration field, and will <u>not</u> enter the calculation of average and percentile values (the Grid model is time dependent and therefore remembers the pollution conditions that occurred one or several hours earlier). The number of hours to be used for this starting up procedure is configured as part of the installation.

The Airviro system requirements of meteorological data differ for different applications. For the purpose of the Gaussian models at least two years of data from an Airviro principal mast (see *Appendix D3.5*) is required in order to carry out seasonal calculations. The Airviro mast data will ensure reliable calculations as well as enabling real time calculations.

If the Grid model is to be applied, the system requires at least one Airviro meteorological mast. If the model will be used for seasonal calculations of mean values and percentiles, Airviro mast data for at least two years is required.

The climatological description (used by the Gaussian model and the Grid model for seasonal calculations of mean values and percentiles) created from historical meteorological mast data should be updated once a year.

D4 Files Used for Dispersion Calculations

D4.1 Calculation Order File and Result File

When a dispersion calculation is requested from the dispersion module the details of the calculation to be carried out are first stored in an order file (or BES file since these files have extension .BES). When the calculation has been carried out the results are appended to the BES file which now becomes a result file (or RES file as the extension is now changed to .RES). The format of these files consists mostly of different chunk identifiers (for example #4711) followed by different arguments which depend on the chunk. A chunk is a unit of related properties. The format is explained in the following sections.

D4.1.1 General Chunks

#2000 <srctype>

<srctype> supported source types:

1	No source.	
2	Street Canyon.	(Dispersion)
3	Road.	(Dispersion)
4	Point.	(Dispersion)
5	Area.	(Dispersion)
6	EDB.	(Dispersion)
7	APEDB.	(Dispersion)
8	Source Location.	(Receptor)
9	Emission Estimation.	(Receptor)

#2001 <areaid> <x1> <x2> <y1> <y2>

<areaid>	Two letters used as an internal definition of the map to use.
<x1>	Lower x coordinate in metres (integer).
<x2>	Upper x coordinate in metres (integer).
<y1>	Lower y coordinate in metres (integer).
<y2>	Upper y coordinate in metres (integer).

#2003 <desc>

<desc>	Text description surrounded by double quotes ('"'). This may contain new lines and all other characters except double quote ("). The first line will be visible in the Dispersion module using the Result Browser dialog.

#2004 <calchgt>

<calchgt>   Calculation height. The height above ground level for output field in metres (real).

D4.1.2 Source Chunks

1. Street Canyon source

#2011   <glob> [<user> <edb>] <elt> <x1> <y1> <housedist> <househgt > <streetw> <streetdir> <emis> <roadtype> <veh> <speed> <typeday> <hour> <scenario> <month>

[Note that this text must be all one long line]

<glob>   If 0, the specified personal EDB is used, otherwise the global EDB is used.

<user>   User id for owner of personal EDB. Only specified when glob is 0.

<edb>   Name of personal EDB. Only specified when glob is 0.

<elt>   Index to substance in the substance list.

<x1>   X coordinate in metres (integer).

<y1>   Y coordinate in metres (integer).

<housedist>   Distance between houses across the street (real).

<househgt>   Surrounding house height (real).

<streetw>   Street width (real).

<streetdir>   Street direction in degrees (real).

<emis>   Emission in mg/ms (real).

<roadtype>   Index to road type in EDB (integer). Index between 1 and number of road types indicates that the emission used should be calculated from EDB using this road type and the search criteria below. If Index is 0, the fix emission given in <emis> will be used instead.

<veh>   Number of vehicles per day (integer).

<speed>   Index to speed table in EDB (integer).Index between 0 and 10

<typeday>   Bit mask for type days to EDB (integer).

Val	Bit	Type	day
1	0	Monday-Thursday	
2	1	Friday	
4	2	Saturday	
8	3	Sunday	
All: 15	0-3	Whole week.	

<hour>   Bit mask for hours to EDB (integer).

Val	Bit	Hour
1	0	00-01
2	1	01-02
4	2	02-03
8	3	03-04
16	4	04-05
32	5	05-06
64	6	06-07
128	7	07-08
256	8	08-09
512	9	09-10
1024	10	10-11
2048	11	11-12
4096	12	12-13
8192	13	13-14
16394	14	14-15
32768	15	15-16
65536	16	16-17
131072	17	17-18
262144	18	18-19
524288	19	19-20
1048576	20	20-21
2097152	21	21-22
4194304	22	22-23
8388608	23	23-24
All: 16777215	0-23	00-24

<scenario>   Index to scenario table in EDB (integer).Index between 0 and 9.

<month>   Bit mask for months to EDB (integer).

Val	Bit	Month
1	0	January
2	1	February
4	2	March
8	3	April
16	4	May
32	5	June
64	6	July
128	7	August
256	8	September
512	9	October
1024	10	November
2048	11	December
All: 4095	0-11	Whole year

2. Point source

#1013   <x1> <y1> <chimhgt> <chimext> <exhspd> <chimint> <exhtemp> <emis>
            <househgt> <housew>

[Note that this line must be one long row]

<x1>	X coordinate in metres (real).
<y1>	Y coordinate in metres (real).
<chimhgt>	Chimney height in metres (real).
<chimext>	Chimney outer diameter in metres (real).
<exhspd>	Exhaust gas speed in m/s (real).
<chimint>	Chimney inner diameter in metres (real).
<exhtemp>	Exhaust temperature in degrees Celsius (real).
<emis>	Emission in g/s (real).
<househgt>	Surrounding house height in metres (real).
<housew>	Surrounding house width in metres (real).

3. Road source segment

#1012 <xn> <yn> <emis>

<xn>   X coordinate in metres (real).

<yn>   Y coordinate in metres (real).

<emis>   Emission in mg/ms (real).

Zero emission indicates last point in a continuous vector sequence. Each road should have two or more of this chunk. Last chunk in a road should have emission set to zero.

4. Area source

#1014 <x1> <x2> <y1> <y2> <plumh> <emis>

<x1>	Lower x coordinate in metres (real).
<x2>	Upper x coordinate in metres (real).
<y1>	Lower y coordinate in metres (real).
<y2>	Upper y coordinate in metres (real).
<plumh>	Plume height in metres (real).
<emis>	Emission in g/s (real).

5. EDB source

#1015

Further information is available on request.

6. Heavy Gas source

#2017   <event> <subst> <x1> <y1> <pipelen> <pipediam> <tankcont> <tankpress>
             <tanktemp> <airtemp>

<event>   Index to event list. Index between 1 and max number of events.
                 Index must correspond to the defined events in the configuration
                 file for the Heavy Gas model.

<subst>   Index to substance list. Index between 1 and max number of
                 substances. Index must correspond to the defined substances in
                 the configuration file for the Heavy Gas model.

       \<x1\>   X coordinate in metres (integer).

       \<y1\>   Y coordinate in metres (integer).

       \<pipelen\>   Pipe length in metres (real).

       \<pipediam\>   Pipe diameter in metres (real).

       \<tankcont\>   Tank contents in kg (real).

       \<tankpress\>   Tank pressure in kPa (real).

       \<tanktemp\>   Tank temperature in degrees Celsius (real).

       \<airtemp\>   Air temperature in degrees Celsius (real).

7. Receptor model database input

#2030   \<type\> \<glob\> \<nrcom\> [\<user\> \<edb\>]

```
TIME<res> <uxfrom> <uxto> <fromd> <fromh> <tod> <toh>
METKEYS<nkey>
<key1> <mask1> <x1> <y1> <hgt1> <len1> <angle1> <diffh1> <name1>
<key2> <mask2> <x2> <y2> <hgt2> <len2> <angle2> <diffh2> <name2>
 ...    ...     ..  ..  ...   ...   ...     ...      ...
<keyn> <maskn> <xn> <yn> <hgtn> <lenn> <anglen> <diffhn> <namen>
CONCKEYS <nkey>
<key1> <mask1> <x1> <y1> <hgt1> <len1> <angle1> <diffh1> <name1>
<key2> <mask2> <x2> <y2> <hgt2> <len2> <angle2> <diffh2> <name2>
 ...     ...    ..  ..  ...   ...   ...     ...      ...
<keyn> <maskn> <xn> <yn> <hgtn> <lenn> <anglen> <diffhn> <namen>
METVAR <nrvar> <simple>
<statnr1> <formula1>
<statnr2> <formula2>
 ...        ...
<statnrn> <formulan>
CONCVAR <nrvar> <simple>
<statnr1> <formula1>
<statnr2> <formula2>
 ...        ...
<statnrn> <formulan>
CRIT <yfrom> <yto> <dfrom> <dto> <weekday> <typeday> <statmask>
CRITFORMULA <nrform>
<critform1>
<critform2>
 ...
<critformn>
ENDREVDB
```

Chunk header:

     \<type\>   Type (integer).

     \<glob\>   If 0, the specified personal EDB is used, otherwise the global EDB is used (integer).

              <nrcom>   Number of common values (integer).

              <user>   User id for owner of personal EDB. Only specified when glob is 0.

              <edb>   Name of personal EDB. Only specified when glob is 0.

TIME:

<res>	Database resolution character: one of the following ,ftqis+* (char).
<uxfrom>	Unix start time (integer).
<uxto>	Unix stop time (integer).
<fromd>	Text start date (YYMMDD).
<fromh>	Text start hour (HH).
<tod>	Text stop date (YYMMDD).
<toh>	Text stop hour (HH).

1	v1
2	v2
4	v3
8	status

METKEYS/CONCKEYS:

<nkey>	Number of meteorological/concentration time series keys.
<key>	Meteorological/concentration time series key.
<mask>	Value mask (integer):

1	v1
2	v2
4	v3
8	status

<x>	X coordinate for station (integer).
<y>	Y coordinate for station (integer).
<hgt>	Station height above ground (integer).
<len>	Length of path, -1 if not applicable (integer).
<angle>	Angle of path, -1 if not applicable (integer).
<diffh>	Differential height of path, -1 if not applicable (integer).
<name>	Verbose name of series. Should contain station name, parameter name, instance and parameter type separated by commas.

METVAR/CONCVAR:

<statnr>	1 if formula exists, 0 otherwise (integer).
<formula>	Formula for this variable.
<nrvar>	Number of variables (integer).
<simple>	

CRIT:

<yfrom>	Start of period within year (MMDD).
<yto>	End of period within year (MMDD).
<dfrom>	Start of period within day (HH).
<dto>	End of period within day (HH).

<weekday>	Index to week day table:	

0	All weekdays.
1	Mondays
2	Tuesdays
3	Wednesdays
4	Thursdays
5	Fridays
6	Saturdays
7	Fridays
14	Monday-Thursday

<typeday>	Index to day type table:

0	All day types.
1	Weekdays (Mon-Thur)
5	Day before holiday (Fri)
6	Holiday eve (Sat)
7	Holiday (Sun)
8	Day between holidays

<statmask>	Bitmask for statuses to use (integer). Bit 0 => status 0, bit 1 => status 1, ... All statuses OK => 65535 (or -1 will do).

CRITFORMULA:
<critform>	Criteria formula (resulting in a Boolean expression).

8. Source location input:

#2031 <plumh> <type> <index> <scenario> <sub> <name>
<plumh>	Plume height (real).
<type>	Type of source, assumption (integer):

0	Constant
1	Monitor
2	Formula
3	Road type

<index>	Index for road type or formula, type 2 & 3 (integer).
<scenario>	Scenario index for road type or formula, type 2 & 3 (integer).
<sub>	For road type, type 3 (integer).
<name>	Name string.

#2032 <type> <index> <scenario> <sub> <fin> <fout>

9. Emission estimation input:

<type>	Type of source, assumption (integer):

0	Constant
1	Monitor
2	Formula
3	Road type

    <index>   Index for road type or formula, type 2 & 3 (integer).
    <scenario>   Scenario index for road type or formula, type 2 & 3 (integer).
    <sub>   For road type, type 3 (integer).
    <fin>   F-in (real). See explanation in *E1.1*.
    <fout>   F-out (real). See explanation in *E1.1*.

#3000

        Model specific resource chunk. Contains lines interpreted as a resource file:
                <entry>: <value>

up to next line beginning with hashmark Ô#'. Interpretation of contents is up to each model.

D4.1.3 Result Chunks

1. Information message chunk

#0100 <infomsg>
      <infomsg> Information message from simulation model. A RES-file may contain any number of this chunk. Display of information message chunks is not yet supported.

2. Information resource message chunk

#0101 <infoid>
      <infoid> Information resource name from simulation mo del. A RES-file may contain any number of this chunk. Display of information message chunks is not yet supported.

3. Warning message chunk

#0200 <warnmsg>
      <warnmsg> Warning message from simulation model. A RES -file may contain any number of this chunk. Display of warning message chunks is not yet supported.

4. Warning resource message chunk

#0201 <warnid>
      <warnid> Warning resource name from simulation model. A RES-file may contain any number of this chunk. Display of warning message chunks is not yet supported.

5. Error message chunk

#0300 <errmsg>
            <errmsg>   Error message from simulation model. A RES-file may contain at most one error chunk.

6. Error resource message chunk

#0301 <errid>
            <errid>   Error resource name from simulation model. A RES-file may contain at most one error chunk.

7. Standard concentration field chunk

#1050 <nx> <ny>
<v1> <v2> ... <vnxy>
            <vr>   Logarithmised value (integer). Calculated with the following formula:

$$vr = 10000 * \log_{10}(value + 2)$$

The value is retrieved using the formula:

$$value = 10.0^{0.0001 * vr} - 2$$

8. Correlation field chunk

#1051 <nx> <ny>
<v1> <v2> ... <vnxy>
            <vr>   Correlation value (real).

9. Emission estimation result

#2052 <tot> <bg> <mcc> <nomonval> <monbg>
<n1> <em1> <std1>
<n2> <em2> <std2>
... ...
<nn> <emn> <stdn>

        <tot>   Number of results (integer).
        <bg>   Background value.
        <mcc>   Multiple correlation coefficient.
        <nomonval>   Number of values used in monitor calculation.
        <monbg>   Background value from monitor.
        <nr>   Number of this result.
        <emr>   Emission for this result.
        <stdr>   Standard deviation of the emission for this result.

10. External Results

#4711
<name1> <pack1> <comm1>
<name2> <pack2> <comm2>
... ...
<namen> <packn> <commn>
EOF

The actual result fields are not within the RES-file, but in separate files. Each external file is represented by a line in this chunk. All result file names have the same prefix but different suffixes.

                <name>   Suffix for this external result file.

                <pack>   Packing method used in this external result file. Consists of a three letter string:

:

Type of field	C	Concentration. Scalar field
	W	Wind field. Vector field
	S	Binary large object (BLOB). Undefined contents

| Field sequence: | O | One field |
| | T | Time series of fields |

| Packing type | P | Plain. No packing |
| | L | L-Packed |

                <comm>   Comment. Description of field visible in the Result Control dialog in the Dispersion module.

D4.1.4 Chunk/Application Cross-Reference

The following list is a summary of the different chunks currently defined, and their relevance to the Dispersion module and Receptor module

Chunk	Chunk desc	Dispersion	Receptor
BES(order file)			
#2000	Source type	Can have	Can have
#2001	Area	Must have	Must have
#2003	Description	Must have	Must have
#2004	Calc. hgt.	Can have	-
#3000	Model spec.	Can have	-
#2011	Canyon	Can have	-
#1012	Road	Can have	Can have
#1013	Point	Can have	-
#1014	Area	Can have	Can have
#1015	EDB	Can have	-
#2017	Heavy Gas	Can have	-
#2030	Rec. Db.	-	Can have
#2031	Src. Loc.	-	Can have
#2032	Em. est.	-	Can have

RES (result file):		(NYI = Not Yet Implemented)	
#0100	Info	NYI	NYI
#0101	Info res.	NYI	NYI
#0200	Warning	NYI	NYI

#0201	Warning res	NYI	NYI
#0300	Error	Can have	Can have
#0301	Error res.	Can have	Can have
#1050	Conc. fld.	Can have	-
#1051	Corr. fld.	-	Can have
#1051	Corr. fld.	-	Can have
#2052	Em. est.	-	Can have
#4711	Ext. result	Can have-	

1. Dispersion:

BES:

Must have:		#2001,#2003	
Can have:		#2000,#2004,#3000	
Can have:		One #2011	Canyon.
	or	Two or more #1012	Road
	or	One or more #1013	Point
	or	One or more #1014	Area
	or	One #1015	EDB
	or	One #2017	Heavy Gas

RES:

Can have:		One or more #0100 or #0101	Information + Result
Can have:		One or more #0200 or #0201	Warning + Result
Must have:		One and only one of #0300	Error, no result
	or	One and only one of #0301	Error, no result
	or	One #1050	Result
	or	One #4711	External result

2. Receptor:

BES:

Must have:		#2001,#2003	
Can have:		#2000,#2030	
Can have:		One #2031	Source location
	or	One #2032 and one or more #1014	Emission estimation

RES:

Can have:		One or more #0100 or #0101	Information + Result
Can have:		One or more #0200 or #0201	Warning + Result
Must have:		One and only one of #0300	Error, no result
	or	One and only one of #0301	Error, no result
	or	One #1051	Source location
	or	One #2052	Emission estimation

D4.2 Controlling Input and Output

When a simulation is requested from the Dispersion module it is sent to the input/output slave (iosim) who in turn passes on information to the input/output master (which could be on another machine). The input/output master controls all information to the models and passes the result back to iosim. The following is a typical example of communication between slave and master during a simulation job execution:

SLAVE		MASTER	
Cocoon			**state:**
"#HELLO"	$\Rightarrow$	Synchronise.	
"#GROUP <grpname>"	$\Rightarrow$		
"#USER <username>"	$\Rightarrow$		
"#ENV <var>=<value>"	$\Rightarrow$		
...			
"#ENV <var>=<value>"	$\Rightarrow$		
"#OPTIONS <options>"	$\Rightarrow$		
"#CWD <workdir>"	$\Rightarrow$		
"#MASTER <masterprg>"	$\Rightarrow$		
"#ENDCONFIG"	$\Rightarrow$		

Start real master program (iosimXX).

Work state:			
Synchronise.	$\Leftarrow$	"#HELLO, LETS GO"	
	$\Leftarrow$	"#START"	
Send BES-file.	$\Rightarrow$	Receive BES-file.	
"#9999"	$\Rightarrow$	End of BES-file.	
Update BES-lock	$\Leftarrow$	"#PERC <%ready>"	
Update BES-lock.	$\Leftarrow$	"#PERC <%ready>"	
... ...	...		
Update BES-lock.	$\Leftarrow$	#PERC <%ready>"	

Finish state:			
Update BES-lock.	$\Leftarrow$	"#READY"	
Write result to RES.	$\Leftarrow$	Write result.	
Release BES-lock.		Exit.	
Exit			

Error state:			
Write error chunk.	$\Leftarrow$	"#ERR <errmsg>"	
Release BES-lock.		Exit.	
Exit.			

D4.2.1 Possible Scenarios.

Cocoon $\Rightarrow$ Work $\Rightarrow$ Finish

            or

Cocoon $\Rightarrow$ Work $\Rightarrow$ Error

D4.2.2 Commands to Slave (iosim) During Work Mode

The slave understands the following commands:

#START   Update lock on the BES-file to indicate 0% ready. This command should be given before reading BES-file and only once during execution.

#PERC <x>   Update lock on the BES-file to indicate x% ready. This command can be given at any time after the #START command and before a terminating command.

#EXTFILE   <ext> [<pack> <comm>]
                Command to store a result field in an external RES-file. The file name is determined by <ext> extension name (suffix). The format of the field is given by <pack> packing mode and <comm> is the comment. This command can be given at any time after the #START command and before a terminating command. The <pack> and <comm> fields are only considered the first time for each <ext> (external RES-file) and may be omitted the following calls. This command should be followed by a binary object of the exact format as the specified packing uses.

#INFO <msg>   Information message text to be written in the RES-file. This command can be given at any time after the #START command and before a terminating command. Note that all messages will be saved and it is up to the master to avoid duplicate information messages.

#RINFO <msgr>   Information message resource name to be written in the RES-file. This command can be given at any time after the #START command and before a terminating command. Note that all messages will be saved and it is up to the master to avoid duplicate information messages.

#WARN <msg>   Warning message text to be written in the RES-file. This command can be given at any time after the #START command and before a terminating command. Note that all messages will be saved and it is up to the master to avoid duplicate warning messages.

#RWARN <msgr>   Warning message resource name to be written in the RES-file. This command can be given at any time after the #START command and before a terminating command. Note that all messages will be saved and it is up to the master to avoid duplicate warning messages.

#ERR <msg>   Error message text to be written in the RES-file. This command can be given at any time after the #START command and is a terminating

command. No result should be sent after this. The master process should exit immediately after cleanup.

#RERR <msgr>   Error message resource name to be written in the RES-file. This command can be given at any time after the #START command and is a terminating command. No result should be sent after this. The master process should exit immediately after cleanup.

#READY   Update lock on the BES-file to indicate 100% ready. This command can be given at any time after the #START command and is a terminating command. Should be followed by a result chunk of some sort which will be literally written to the end of the RES-file. After that the master process should exit immediately after cleanup.

D4.3 Data Flow for Dispersion Calculations

There are two stages in a dispersion calculation. First the calculation order is sent by the Dispersion module to the input/output slave (iosim). After this there is no direct interaction between the two processes.
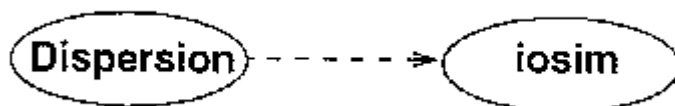
It is now the responsibility of iosim to make sure that the calculation is processed and the calculation is passed on to the input/output master (here called iosimXX). There is a different master for different types of calculations. The master may even be on another host machine and may in turn call independent dispersion models if necessary. The slave iosim coordinates the reading and writing of the order file and result file (BES file or RES file). When the calculation is finished then a message is sent to the Dispersion module indicating this. If there is no Dispersion module running then the message will appear next time it is started. Also the Dispersion module may request to watch the progress of the calculation.
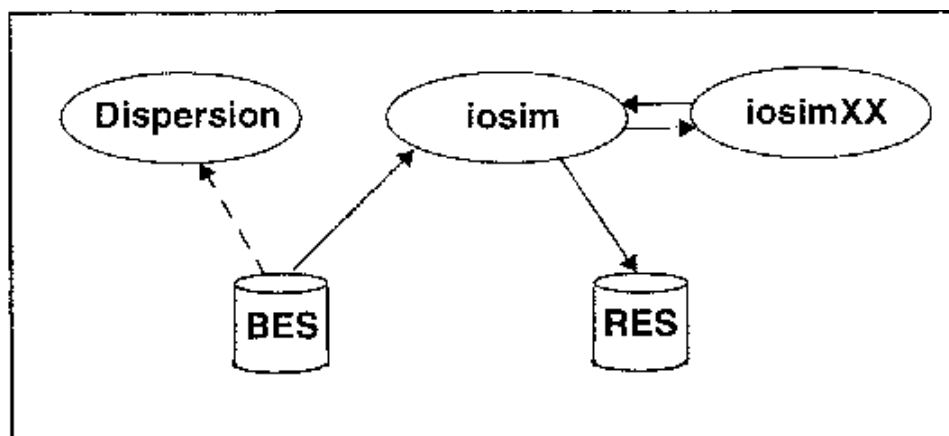

Figure D4.3.i: The interaction of iosim with the Dispersion module

D4.4 Dispersion Characteristics for the Case Calculations within the Gauss and Street Canyon Models

The dispersion characteristics for the Case calculations are configured as part of the installation procedure. The parameters that may be specified by the customer are:

- definition of up to 10 different stability regimes (defined by the inverse Monin-Obukhov lengths)

- typical mixing height, absolute temperature and temperature (lapse) rate for each stability class

- dispersion coefficients s_y and s_z expressed as functions of distance from the source

Note that case dispersion calculations may be performed without any meteorological input data from the time series database. All information is introduced by the user. Also note that case simulations do not use the wind model, which means that the local topography and surface roughness is not taken into account.