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ROADAIR 3.11

User's Manual

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Summary

ROADAIR is a model for calculation of air pollution from road traffic. Air pollution near individual links of entire road networks can be calculated efficiently. The model can be utilized both for street canyons and roads in sparsely built-up areas. The model focuses on the parameters for which there exist air quality guidelines which are exceeded as a result of traffic emissions, and the components which contribute to the total emissions in Norway. Emissions of CO_2, CO and NO_x ($NO+NO_2$) are calculated. Maximum concentrations of CO, NO_2 and PM_{10} (particles with diameter less than 10 µm) are also calculated. Estimates of concentrations from large road junctions can also be performed.

The emission factors for CO and NO_x (g/km) are dependent on vehicle class, vehicle speed and road gradient. Fuel consumption is dependent on vehicle class and vehicle speed. Emissions of CO_2 is based on fuel consumption.

Technological development has been accounted for and, hence, calculations can be performed to year 2008. The accuracy of the calculations are reduced with the number of years into the future.

Different dispersion models are utilized for calculation in street canyons and roads in sparsely built-up areas. The maximum concentration is calculated at a chosen distance from the curb. Maximum concentrations occur when rush-hour traffic and extremely poor dispersion conditions occur at the same time. Exposure at the facade of the residential buildings near the roads are also calculated. Concentrations and number of persons experiencing nuisance are compared to air quality guidelines given by the State Pollution Control Authority. The number of persons experiencing nuisance is estimated based on NO_2-concentrations. The calculation of nuisance is uncertain, especially for future situations, because the relationship between NO_2-concentrations and nuisance (odour, soiling) may change over time.

The ROADAIR 3.11 version has been improved both concerning content and structure/appearance compared to earlier versions of the model. The most important changes are:

- revised model for dispersion in street canyons ("Operational Street Pollution Model").
- the emission calculations of CO and NO_x are updated in accordance with new emission requirements and classification of vehicle.
- the concentration and exposure calculations includes PM_{10}.
- flexibility on what to calculate (emissions/concentrations/exposure).
- the maximum distance to point of calculations has increased.
- there is an option for a simplified calculation of concentrations near crossroads/ interchanges.
- the programme is documented.

ROADAIR 3.11 calculates exposure at buildings in addition to exposure at residential units.

A complete description of the different modules in this model is described in "Programme documentation ROADAIR Version 3.11" (Bekkestad, 1996).

ROADAIR 3.11

User's Manual

1. Introduction

ROADAIR was first developed at the Norwegian Institute for Air Research for use on PC in 1989. ROADAIR is a model utilized for calculating emissions, concentrations and exposure of the population to air pollution near defined road networks. The programme may also be used to investigate pollution along single road links, but was not developed with this in mind. ROADAIR has to a large extent been developed to suit the needs of the Directorate of Public Roads in Norway, in connection with their transport planning activities.

The emission calculations are based on emission matrices given in the Nordic Method for Car Exhaust Pollution (NMR, 1984). These matrices have been modified to account for road gradients and changes in emission factors due to renewal of the vehicle fleet.

For roads in open areas, concentrations are calculated by the use of a modified version of the EPA model HIWAY 2. For roads with continous building structures on one or both sides ("streets canyons") the Operational Street Pollution Model (OSPM) developed by the Danish National Environmental Research Institute (NERI) is used.

Measurements of air pollution in the Scandinavian countries and simultaneous registrations of traffic data and meteorology have been utilized to determine the validity of the model.

This manual gives a guideline to the most important input data in order to achieve the best results.

This user's manual describes briefly the methods used in ROADAIR. For more detailed information, we refer to the programme documentation (Bekkestad et al., 1996).

2. What is calculated by ROADAIR?

- **Emissions of CO, NO_x and CO_2 from the traffic on each road link**, as well as from the entire road network. It is possible to calculate separately the emissions from

  * light duty vehicles,
  * heavy duty vehicles, and
  * buses.

  Estimates may also be performed for minor roads not included in the road network.

Estimates may also be performed for minor roads not included in the road network.

Emissions are given separately for three city zones (outskirts, intermediate areas, and central areas). The calculated CO_2 emissions also include CO, since CO eventually is converted to CO_2 in the atmosphere.

Table 1 gives as an example prognostic CO emissions from main roads in the Rogaland region in Norway in 1998.

Table 1: Total emissions for each vehicle class and area type as presented by ROADAIR.
Example: CO from roads in the county of Rogaland. Similar tables for NO_x and CO_2 are given in the result file.
Low traffic r. = Emission from low-traffic roads, not included in the defined road network. (These emissions are set equal to zero in this example.)

	Emission of CO (carbon monoxide) (tonnes/year)			
	Scattered	Medium	Dense	Total
Light duty vehicles	293.6	1 398.1	3 956.9	5 648.6
Heavy duty vehicles	13.3	40.5	122.4	176.2
Buses	1.0	3.7	7.2	11.9
Subtotal	307.8	1 442.4	4 086.4	5 836.6
Low traffic roads	0	0	0	
Total	307.8	1 442.4	4 086.4	5 836.6

- **Concentrations of CO, NO_2 an PM_{10}** at a chosen distance from the curb, for each road and link. In street canyons the concentrations are calculated at the building facades. Along roads in open areas, the distance from the curb to the point of calculation is chosen by the user uniformly for the whole road network. The concentrations represent the expected maximum value (CO and NO_2: 1 h max; PM_{10}: 24 h max). The calculated concentrations include the urban background concentration.

  The programme calculates the number and length of road links for which different concentration limits for CO, NO_2 and PM_{10} are exceeded.

  The different levels are for presented below for each of three components:

CO (mg/m³)	NO_2 (µg/m³)	PM_{10} (µg/m³)
>25	>400	>400
>15	>350	>350
> 8	>320	>300
> 0	>280	>250
	>240	>200
	>200	>150
	>150	>100

The air quality guidelines given by the State Pollution Control Authority (SFT) are 100 µg/m³ for 1-hour average (NO_2) and 70 µg/m³ for 24-hour average (PM_{10}). it is most common to compare the concentrations of CO with the 8-hour air quality guideline given by SFT (8 mg/m³). However, the model calculates 1 hour maximum concentrations of CO, and the 1-hour maximum of 15 mg/m3will coincide with an 8-hour air quality guideline of 10 mg/m³.

- **Road dust deposition** (g/m² · month) along each road link (Table 2). The model is valid for the dry part of the winter season in areas where studded tyres are used extensively during winter, such as in Norway. The number of road links and the length of the roads in the four road dust classes are given for three city zones (see chapter 3.2.1 "Area type, OTY").

Table 2: Classification of road dust deposition (road dust class).

Road dust class	1	2	3	4
Description of severity of dust deposition	Low	Medium	High	Severe
Dust deposition (g/m²·month)	<5	5-10	10-20	>20

- **Population exposure to CO, NO_2 and PM_{10}**, given as the number of people exposed within three concentration ranges for CO, and eight concentration levels for NO_2 and PM_{10}. The pollution exposure is calculated at the facade of residential units, 3 m above ground level (the values include background pollution).

- **Nuisance from air pollution** experienced by persons in their residences. "Nuisance" is presented as the number of people severely bothered by air pollution (smell and dust) from road traffic in each area type. This part of the model has considerable uncertainty, especially for future situations. We have defined a parameter which is meant to express the nuisance due to the combined effect of smell and dust/filth. A health investigation carried out in Oslo of people's experience of nuisance as a function of concentration levels of NO_2 has been used as background for this module (Traffic and Environment, 1991).

3. Input data

3.1 Flexibility versus simplicity

ROADAIR is run interactively. The programme reads input data from:

* a file with data describing road links and traffic
* a file with data describing the position of buildings
* the computer terminal, by user dialogue.

The input file is read line by line. No data is interpreted as input data until a line is reached where the first five positions contain the word start/Start/START. The lines above this point may be used for comments. Data are read until the limit of 2 000 road links is reached, or the end-of-file sign appears. Characters other than "blank" or a number in position 1 on a line, are interpreted as end-of-file.

The following parameters are given by the user during programme execution:

- Year of computation. The traffic data are given for this year. The changes in the vehicle fleet, relevant for emission changes, are built into the model. The changes are valid for the Norwegian car fleet.

- Background concentrations. "Background" means city background, i.e. the contribution to the concentrations in the street originating from all other emissions except the emissions from the traffic in the street itself. The background levels are often not well known, and it may be useful to carry out calculations for varying background levels. Proposed urban background levels are given, as a function of city size and position within the city. By assuming zero background level, the contribution from the single road can be found separately.

- Whether the calculations are to be performed for a road junction (yes/no).

- Distance from the curb to point of concentration calculation of suspended particles, CO, NO_2 and PM_{10} for "open" roads (no building facades). This will introduce a few questions concerning tyres used (studded, light-studded and non-studded tyres), and the effect of road cleaning.

- Whether to add emissions from roads not included in the defined road network (yes/no). In many cases only the main road network will be defined on the input files. Based on certain assumptions, it is possible to add emissions from the remaining roads. This is given as vehicle-km per 24 hours for three area types.

- Whether population exposure to air pollution should be calculated (yes/no). This is possible only if a building file is available, in which buildings along the roads are linked to a specific road.

- The average number of persons per residential unit.

3.2 Description of input files

3.2.1 Road and traffic data

Table 3 below contains a list of the road and traffic parameters needed for programme execution. Each line in the file represent one road link. The table shows whether the number should be given as an integer or a real number, the number of spaces assigned to each parameter and its position on the line. The numbers should be aligned to the right within the given position intervals. In the case of real numbers given with a decimal point but no decimals (e.g. 24.), the

decimal points counts as one position and should be adjusted to the right. There is no connection between the different links, hence, one link will not affect a neighbouring link.

Table 3: Road and traffic data.

Parameter, abbreviation	Position on a line	Integer-I Real-R Arbitrary character - A	Range, if any	Max. No. of digits
Road link number, LNR	1- 5	I		5
Road link identification	7- 27	A		20
x-coordinate (from)	52- 58	I		6
y-coordinate (from)	61- 67	I		6
x_2-coordinate (to)	70- 76	I		6
y_2-coordinate (to)	79- 85	I		6
Road class, GKL	88- 89	I	1- 2	
Road width, KB	92- 96	R		5
Distance curb-facade, FA	99-103	R		5
Gradient of the road, ST	106-110	R		5
Length, L	113-119	R		7
Direction, RE	122-123	I	0- 2	
Area type, OTY	126-127	I	1- 3	
Facade coverage, FD	130-131	I	1- 6	
Fraction of heavy duty traffic, TA	134-138	R	0-100	
Annual average daily traffic, AADT	141-148	R		8
Vehicle speed, V	151-155	R		5
Average daily bus traffic, AADT-B	158-163	R		6
Rush hour traffic, M_{max}	165-172	R		7
Vehicle speed during rush hour, V_{max}	175-179	R		5
Rush hour TA, T_{max}	182-186	R	0-100	
Bus traffic during rush hour, B_{max}	189-193	R		5
Standard class, STK	196-197	A+I		2

In the following, each of the parameters are explained in more detail.

Road link number, LNR, is a unique identification of the road link and may be given values from 1 to 99999. The links do not have to be in numerical order on the input file. The maximum number of links is 2 000. If the input file contains more than 2 000 links the programme execution will be interrupted. Roads should be devided into links such that all the parameters in table 3 are uniform along the length of the link.

Road link identification, may concist of 20 arbitrary alphanumeric characters (name, number, etc). The road link identity is not used for programme execution, but is necessary to identify each separate link in the result file.

Coordinates (x, y, x_2, y_2) for the end points are found from a map. The co-ordinates are not necessary input data for calculations with ROADAIR, but are used for plotting of the results for a road/network, and also for calculation of the road length if this is not given.

Road class, GKL, describes the function of the road. Except for GKL = 5, the classification used in ROADAIR corresponds to the Nordic Method for Calculation of Car Exhaust Pollution (NMR, 1984).

GKL=1: ***Main road/through fare road***

Main road leading towards the city centre, leading through the centre or a ring road passing through semicentral areas. The traffic intensity reaches distinct maximum values during morning and afternoon rush hours, and contains a fairly large fraction of heavy duty traffic.

GKL=2: *Main road in* ***central city area***

Road for local traffic within the central areas of the city or town. The traffic intensity is more evenly distributed throughout the day than for GKL = 1. The driving mode along a GKL= 2 may be uneven, with frequent disturbances causing acceleration/retardation. Smaller fraction of heavy duty traffic than GKL=1, unless the number of buses is very high.

GKL=3: *Main road in* ***residential area***

Road directing traffic from/to one or more residential areas. The traffic distribution is characterized by maximum intensity during rush hours, and the fraction of heavy duty traffic is low.

GKL=4: *Main road in* ***industrial area***

Road leading traffic from/to a major industrial complex. The fraction of heavy duty traffic is high.

GKL=5: *Local road in* ***residential area***

Traffic intensity distribution and fraction of heavy duty traffic similar to GKL = 3. Uneven driving mode.

As can be seen, this classification is adapted to cases where the calculation area is a city or urbanized area. ROADAIR has frequently been used in cases where the calculation area includes both urban areas, rural areas and major highways in the same road network. Highways belong to GKL = 1, and the remaining roads in rural areas can often be classified as GKL = 1 or GKL = 5.

The road class parameter is used to assign standard values for speed in rush-hours and fraction of heavy duty traffic for situations in which these are not known. GKL is also used to assign cold start fractions and directional distributions.

Road width, KB. The road width should be given in meters (distance between the roadway curbs). The road width is used in the dispersion calculations. If the data are punched manually, the road width should be obtained from a map with scale 1:1000.

Distance curb-facade, FA. The distance should be given in meters (distance from curb to facade of adjacent buildings). This parameter is only utilized for FD = 1 or FD=2 (dense facades on one or both sides). For FD = 2, the distance to the **closest** building should be used. The distance can be obtained from a map (scale 1:1000) or from measurements in the field.

Gradient of the road, ST. The gradient is given in percent. For one-way traffic the gradient is defined in respect to the traffic direction (positive upwards). For roads with two-way traffic, the programme defines the percent of the traffic going upwards and downwards based on GKL. The maximum gradient allowed in the model is 12%. Gradient is of importance when calculating emissions.

Length, L. The length of the link given in meters. This parameter must be given in order to calculate emissions correctly.

Direction, RE. To-way traffic: RE = 0. One-way traffic: RE = 1. One-way traffic in the opposite direction: RE = 2.

Area type, OTY. The area type determines the background value of air pollution along each road link.

The area of calculation is usually a city and its surrounding built-up areas. The area type parameter is given a value based on the area in which the road link is situated:

OTY=1: **Sparsely built-up area**. Areas outside cities and densely populated areas, and areas with scattered housing.

OTY=2: **Medium built-up area**. Built-up areas outside down-town, satellite towns, small villages and developing areas.

OTY=3: **Densely built-up area**. Down-town with often continuous rows of facades and "dense" housing.

Background pollution is the general level of pollution in the area which is not caused by the road itself, but originate from emissions from other sources in the area. The background pollution has a larger effect on the total concentration level along a road the lesser the traffic.

Background pollution comes from heating, traffic and industry. The pollution is usually highest in the center and decrease towards the outskirts. Chapter 6.5 gives proposed background levels used in Norway, when measurements are not available. Table 10 shows the relation between the density of built-up areas and background pollution level. The density of buildings is, hence, not the important factor (although it can be utilized as a first estimate). A densely populated area with primary electrical heating does not contribute to high background pollution levels. The traffic intensity will be the main source. Similarly, a main road through an area with scattered housing will contribute to the background pollution at smaller road links nearby.

Facade coverage, FD. The following values are employed in the calculations:

1. Continuous facades along one side of the road. For road width (FA) <15 m, the length of the row of facades should be >75 m.
2. Continuous facades along both sides of the road. For road width (FA) <15 m, the length of the row of facades should be >50 m.
3. Scattered buildings and/or vegetation.
4. Open area (including bridges).
5. Special topography, e.g. steep hill, high wall.
6. Tunnel.

For FD = 1 and 2, the OSPM dispersion model developed by NERI (1989a, 1989b) is used. For FD = 3, 4 or 5, a modified version of HIWAY 2 is used. FD = 5 can be used when there is a topographic difference between the base of residential unit and the connecting road link. The calculation results should be evaluated separately. For FD = 6 (tunnel) no concentrations are calculated. In the results file concentration values of 99.0 $\mu g/m^3$ and 999.0 $\mu g/m^3$ are assigned for FA=6, to indicate high pollution levels for CO and NO_2, respectively. ROADAIR is of course not a valid model for tunnels, but tunnels are included in the calculations of emissions because the traffic there contributes to the total emissions.

A change in FD gives reason to introduce a new road link.

Fraction of heavy duty traffic, TA. The ratio of heavy duty vehicles (gross vehicle weight greater than 3.5 tonnes, including buses) is given as percent of the total traffic volume. The distribution of different vehicle classes within the groups of light and heavy vehicles are default values in the programme. If TA is given as -1 (missing) in the input file, the default values given in Table 4 will be used. TA has a major impact on calculations of total emissions of NO_x, and concentration of NO_2 and dust (PM_{10}), and it is essential that the values assigned are as realistic as possible.

Table 4: Standard values of heavy duty traffic (TA) as a function of road class (GKL).

Road class (GKL)	TA (%)
1. Main road/through fare road	10
2. Main road in central city area	6
3. Main road in residential area	4
4. Main road in industrial area	12
5. Local road in residential area	6

Annual average daily traffic, AADT. Annual average daily traffic for one road link, given as vehicles per 24 hours. AADT is used to calculate emission per year of the different components. AADT is the basis for calculating total emissions,

and is used to give standard values to M_{max} (see below) if M_{max} is assigned no value in the input-file.

Vehicle speed, V. Daily average traffic speed, km/h. The weighted average vehicle speed should be used. If there does not exist any registrations of speed, then the speed limit at the link can be used. Vehicle speeds less than 10 km/h are set equal to 10 km/h, and vehicle speeds greater than 90 km/h are set equal to 90 km/h.

Average daily bus traffic, AADT-B. Number of buses per 24 hours. The fraction of buses should be included in TA. Data should be stated to the nearest:

* 20 vehicles/day for AADT-B <200
* 50 vehicles/day for AADT-B ≥200

Buses in cities have different emissions than other heavy duty vehicles because of the non-uniform driving pattern.

A separate parameter for the intensity of buses enables the programme to calculate the emission from public transport separately.

The programme does not automatically estimate the effect of a better public transport system, because there is no coupling between bus intensity and total traffic intensity in the model.

Rush hour traffic, M_{max}. The maximum expected hourly traffic, given as vehicles per hour. If M_{max} is given as 0 in the input file the default values in Table 5 will be used.

Table 5: Default values for M_{max} as function of road class.

Road class (GKL)	M_{max} (%)
1. Main road/through fare road	10
2. Main road in central city area	8
3. Main road in residential area	10
4. Main road in industrial area	10
5. Local road in residential area	8

Vehicle speed during rush hour, V_{max}, given in km/h. If no value is given, V_{max} is set equal to V. V_{max} is utilized in calculations of maximum concentration and exposure. It is therefore important that realistic values of V_{max} are assigned.

Table 6 show some suggested values for V_{max} in city streets which may be used if there exist no data of V_{max}.

Table 6: Suggested values of V_{max} during rush hours when no data of V_{max} exists. These are not standard values given in the programme.

Road Class (GKL)	V_{max} (km/h)	
	Street with traffic below its capacity limit	Street with traffic intesity that has reached the capacity limit
1	45	30
2	40	30
3	45	35
4	50	40
5	40	30

Fraction of heavy duty traffic during rush-hours, T_{max}. Percentage of heavy duty vehicles during rush-hour (including buses). If no value is given, TA is given as default value by the programme. However, most often T_{max} will be lower than TA because the rush-hour traffic is usually dominated by light duty vehicles.

If T_{max} is assigned a value of 0 in the input file, the programme will calculate as if there were no heavy duty traffic. If T_{max} is assigned a value of -1, the programme will utilize the daily average values for heavy duty traffic (TA).

T_{max} and M_{max} forms the basis for the calculations of maximum concentration and exposure. It is therefore important that realistic values of T_{max} are assigned.

Bus traffic during rush-hours, B_{max}. Maximum number of buses per hour during rush hours. If B_{max} is assigned a value of 0, it is assumed that there are no buses at the road link during rush-hours. If B_{max} is given the value -1 in the input file, it will be calculated based on AADT-B, resulting in a fraction of buses during rush-hour that equals the average number of buses per 24 hours.

B_{max} is used to estimate the contribution from emissions from buses to the maximum concentration.

Table 7 shows an example of an input file.

Table 7: Input file with road and traffic data.

LNR	Name/ reference	x	y	x_2	y_2	GKL	KB	FA	ST	L	RE	OTY	FD	TA	AADT	V	AADT-B	M_{max}	V_{max}	T_{max}	B_{max}
Start																					
1	EV 125862978	142590	-18240	142515	-18025	1	15	0	0	230	0	3	4	10	26 600	60	200	0	45	0	0
2	RV 806295836	142515	-17025	142290	-18090	1	7	0	0	240	0	2	3	0	11 000	50	50	0	30	0	0
3	RV 284597310	142290	-18090	142065	-18115	2	7	0	0	220	0	2	3	0	10 500	50	40	0	50	0	0
4	RV 795168437	142065	-18115	141135	-17890	2	7	0	0	980	0	1	6	5	9 700	50	0	0	35	0	4
.		.	.	.	.																
.	etc.	.	.	.	.																
.		.	.	.	.																
400	EV 158947265	141036	-17790	140950	-17715	2	7	0	0	110	0	1	3	7	7 800	50	50	70	0	0	0
403	EV 458726511	141135	-17890	141036	-17790	2	7	0	1	140	0	1	3	0	6 000	50	40	70	0	0	0
403	RV 581436967	141725	-17890	141600	-17790	2	7	0	1	140	0	1	3	0	2 000	50	0	70	0	0	0
430	RV 745296362	141036	-17790	140950	-17715	2	7	0	0	110	0	1	3	0	2 000	50	0	70	0	0	0

3.2.2 Building data

The file with building data is utilized when calculating the population exposure to CO, NO_2 and PM_{10}. Exposure is here defined as the maximum concentration in the air at the facade of the residential unit. The maximum concentration 3 m above ground is calculated.

The data needed for ROADAIR to calculate the air pollution exposure to the population are: distance to buildings, building height, number of residential units per building and the corresponding road link number.

All buildings within 100 m from the curb on each side of the road should be included in the register. All lines before the one starting with start/Start/START in the first 5 positions of a new line are interpreted by the programme as comments.

For each consecutive line the programme reads:

* Position 46-47: Number of floors in the building.
* Position 66-67: Number of residential units in the building.
* Position 73-77: The corresponding road link number.
* Position 81-83: Topographical difference between the ground level of the building and the corresponding road.
* Position 85-87: Distance from centre of road to building facade.

The reason for reading data from these positions on the file only, is that prior to the development of ROADAIR, there already existed building registers that had been established by Norwegian Road Authorities for noise calculations. These contain a lot more data than is needed for the air pollution calculations.

The number of residents per building unit is given as part of the user dialogue. The number is chosen uniformly for the total area of calculations.

3.2.3 Screen dialogue, or situation file

The data concerning the whole road network or the calculation situation were previously given in a screen dialogue, where the different questions are answered by the user during programme execution. Examples of such information are year of calculation, background concentration, and whether exposure is to be calculated.

The programme execution is made more effective in this version of ROADAIR. When using a situation file, one or more of the parameters can be changed in the file and a new programme execution can be performed.

The user should, however, be aware that changing 'no' to 'yes' in the situation file might result in additional questions from the programme during execution and, hence, if the additional answers are not added in the situation file, the programme execution will abort.

The name of the situation file may have one to eight characters, and an "extention" of up to three characters (i.e. "sitfile.run").

3.2.4 Error messages

If one or more parameters are misplaced in the input file, this may lead to wrong results for the link(s) or interruption of programme execution. This depends on the type of error in the input file. The programme does not produce error messages for all errors and inconsistencies in the input file, but the following tests are utilized by the programme:

* Road class: GKL between 1 and 5.
* Road width: KB >0
* Directional parameter (RE): 0, 1 or 2.
* Area type: OTY 1, 2 or 3.
* Facade coverage: FD between 1 and 6.
* Heavy duty traffic: TA and T_{max} between -1 and 100 (-1 means that the standard values will be used).
* Sum: AADT and AADT-B >0.
* L, M_{max} and $V_{max} \geq 0$.
* Ratio buses of total traffic ≤ratio of heavy duty traffic.
* $B_{max} \leq$ AADT-B
* $M_{max} \leq$ AADT
* $B_{max} \leq M_{max}$
* $B_{max} > -1$.
* $B_{max} \leq T_{max}$.

4. Programme execution

4.1 Execution of ROADAIR from DOS with situation file

Programme execution is initiated by typing

> ROADAIR311 < Sitfile.run

Sitfile.run is the name of the situation file. This file contains all information the programme needs for execution. Information to the user from the programme (of the type "Concentration calculations are beeing processed") is given on the screen.

4.2 Execution of ROADAIR from DOS with screen dialogue

The questions asked by the programme when executing ROADAIR from DOS with screen dialogue, will correspond to the lines in the situation file.

When ROADAIR is initiated by typing

> ROADAIR311

the following will appear on the screen:

(The comments in square brackets [ ] is not a part of the screen dialogue, but explains the execution, dependent on what the user chooses).

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File name for file containing road link data:

Give the name of the file. If the file is situated in another directory than the directory in which ROADAIR was initiated, this has to be specified. The programme accepts file names of up to 80 characters.

If the file name given does not exist, an error message will appear: "File not found", and the programme execution will be interrupted.

Year of calculation (1993-2008):

Emissions from different vehicle classes will change over time, dependent on the rate of change of the vehicle fleet and emission requirements for new cars. For the years after year 2008 the predictions of the technological development are not very reliable, and hence have no purpose.

Are the calculations to be performed for a road junction (Y/N)?

[If 'Y', go to 1.1. If 'N', go to 2.1]

If the answer to this question is 'yes', ROADAIR will not perform the usual calculations for road systems. Instead, the programme performs calculations of emissions and concentration for a road junction.

[1.1] Name of result file for concentrations:

The file name can consist of a maximum of eight characters before the period, and in addition three characters after the period. If the file name already exists, the old file will be overwritten.

DUST DEPOSITION:

**For roads with facades on one or both sides,
dust deposition (g/m^2*month) is calculated 5 meters from the curb.
For roads without facades, dust deposition can be calculated
either 5, 10 or 20 meters from the curb.**

Give distance (5, 10 or 20 meters):

This question relates to dust deposition and not PM_{10}.

**[1.2] Country-averaged tyre use in 1991/92:
Ratio with normal-studded tyres: 0.76
Ratio with light-studded tyres: 0.04**

These numbers are suggested values. The fraction of studded tyres will vary from place to place, and it is expected that the fraction of non-studded tyres will increase in the future. The user should therefore try to obtain updated values for future calculation situations.

Normal studs are referred to as the weight of the studs used for light duty vehicles (gross weight <3.5 tonnes) until October 1, 1992 (1.8 g per stud). The maximum allowable stud weight is now 1.1 g per stud and the studs are hence called "light studs".

There has not been a reduction in maximum stud weight for heavy duty vehicles (gross weight >3.5 tonnes). These studs are still called "normal" studs and weigh 3.0 g.

As of today there exist only two types of studs, and trucks, station wagons etc. have a maximum allowable stud weight of 1.1 g. This will, however, undergo a change in the near future and there will be a third group/class of studs for these cars with a stud weight of 2.3 g per stud.

NILU's estimate of road dust formation from different types of tyres:

Reduction factor for road wear from light-studded tyres compared to studded tyres: 0.7

Reduction factor for road wear from non-studded tyres compared to studded tyres: 0.05

A reduction factor of 0.7 indicate that it is expected that the road wear from light-studded tyres is 70 % of the road wear from normal studded tyres.

It is a fact that the road wear is proportional to the weight of the stud. The road wear of non-studded tyres compared to studded tyres are not that well known. We suggest to use the values given above.

Do you want to use these values (Y/N)?

[If 'Y', go to 1.4. If 'N', go to 1.3.]

[1.3] **Ratio of studded tyres (0.0-1.0):**
Ratio of light-studded tyres (0.0-1.0):
PM_{10}-reduction factor, studded tyres (0.0-1.0):
PM_{10}-reduction factor, non-studded tyres (0.0-1.0):

It is possible for the user to give other values.

[1.4] **The effect of road cleaning on the amount of dust deposition and PM_{10} concentrations:**

1.0 = no effect
0 = full effect

Observe that the question is not whether or not cleaning is performed, but what the effect of such a cleaning would be. The dust concentrations are multiplied with the given factor. The effect of cleaning has not been investigated in much detail, but it is included in the model in case such knowlegde will appear.

Do you want to use 1.0 (Y/N):

[If 'Y', go to 1.6. If 'N', go to 1.5.]

[1.5] **Factor for effect of cleaning (0.0-1.0):**

[1.6] **Reading of input data.**
Completed reading of input data.
Concentration calculations are beeing processed.
The results are stored in the file: *conc.res*.

Conc.res is in this situation the file name given by the user at the beginning of the programme execution. Programme execution for a road junction has terminated.

If you have chosen not to do calculations for a road junction, then the ordinary road system calculations are performed. You will get the following questions:

[2.1] **Do you have a file with building data (Y/N)?**

[If 'Y', go to 2.2. If 'N', go to 2.3.]

Previously, building data were only necessary to calculate exposure. However, building data are now utilized also for dispersion calculations in street canyons if they are available. The dispersion calculations will be more accurate if building data exists.

[2.2] **Name of file with building data:**

The name may consist of eight characters, and a three character extension.

[2.3] **EMISSION:**

Name of result file for emissions:

The name may consist of eight characters and a three character extension.

Are emissions from roads not included in the defined road network to be calculated (Y/N)?

[If 'Y', go to 2.4. If 'N', go to 2.5.]

[2.4] **Vehicle-km per 24 hours, densely built-up area:**
Vehicle-km per 24 hours, medium built-up area:
Vehicle-km per 24 hours, sparsely built-up area:

Most often only the main road network will be included in the road link file, i.e. roads with AADT above a certain limit. If it is desirable it is possible to take into account the traffic on the other roads when calculating the total emission from the road system. It does, however, require that one is able to estimate the total traffic work on this road network (vehicle-km per 24 hours). These roads are also called secondary roads or the low traffic road network.

You are now finished giving data for roads outside the defined road network.

[2.5] **CONCENTRATIONS:**

Name of result file for concentrations:

The name may consist of eight characters, and a three character extension.

The background concentrations for area type "scattered housing/sparsely built-up" are given (default values) in the programme. (CO=1 mg/m^3, NO_2=5 µg/m^3, PM_{10}=30 µg/m^3 and O_3=60 µg/m^3.)

Proposed background values for area type "dense" and "medium built-up" are given based on the population in the city/town (see Table 10).

Index for population:
1: > 200 000
2: 50 000 - 200 000
3: < 50 000

Give index for population:

The programme suggests background concentrations based on the size of the city.

CO background concentration (mg/m^3) based on population:

Medium built-up area: 6.7 (index = 1), 4.0 (index = 2), 2.7 (index = 3)
Densely built-up area: 10.7 (index = 1), 6.4 (index = 2), 4.3 (index = 3)

CO background concentrations OK (Y/N)?

[If 'Y', go to 2.7. If 'N', go to 2.6.] The user can accept these values, or give other values.

[2.6] **CO - dense (0-15 mg/m^3):**
CO - medium (0-15 mg/m^3):

It is possible to suggest other values here.

[2.7] **NO_2, PM_{10} and O_3 (µg/m^3)**

NO_2 background concentrations based on population index:

Medium built-up area: 43 (index = 1), 25 (index = 2), 17 (index = 3)
Densely built-up area: 68 (index = 1), 39 (index = 2), 27 (index = 3)

NO_2 background concentrations OK (Y/N)?

[If 'Y', go to 2.9. If 'N', go to 2.8.]

[2.8] **NO_2 - dense (0-150 µg/m^3):**
NO_2 - medium (0-150 µg/m^3):

It is possible to suggest other values here.

[2.9] **PM_{10} background concentrations based on population index:**

Medium built-up area: 60 (index = 1), 50 (index = 2), 40 (index = 3)
Densely built-up area: 120 (index = 1), 100 (index = 2), 80 (index = 3)

PM_{10} background concentrations OK (Y/N)?

[If 'Y', go to 2.11. If 'N', go to 2.10.]

[2.10] **PM_{10} - dense (0-300 µg/m^3):**
PM_{10} - medium (0-300 µg/m^3):

It is possible to suggest other values here.

[2.11] **Default value for background ozone concentration in Norway (used to calculate maximum 1-hour NO_2 concentrations in the city during winter) = 60 µg/m^3.**

Ozone background concentrations OK (Y/N)?

[If 'Y', go to 2.13. If 'N', go to 2.12.]

[2.12] **Regional ozone (0-200 µg/m^3):**

[2.13] CONCENTRATIONS OF CO, NO_2, AND PM_{10}

For roads with a continuous facade on one or both sides of the road (street canyons), the concentrations are calculated at the facade of the houses. For non-canyon ("open") roads, the calculations are performed for the chosen distance. For distances of calculation of more than 60 m, the concentrations are always calculated as without facade coverage.

Distance from curb to point of calculation along open roads (0-99 meters):

Concentrations are calculated for the same distance for the whole road network.

DUST DEPOSITION:

For roads with facade rows on one or both sides, calculations of dust deposition (g/m² * month) is always calculated 5 metres from curb. For roads without facades, dust deposition is calculated 5, 10 or 20 metres from curb.

Give the distance (5, 10 or 20 meters):

[2.14] **Country average use of tyres in 1991/92:**
Fraction of tyres with normal studs: 0.76
Fraction of tyres with light studs: 0.04

These numbers are suggested values. The amount of studded tyres will vary from place to place, and it is expected that the fraction of studded tyres will decrease in the future. The user should therefore try to obtain updated values for future calculation situations.

NILU's estimates for dust generation from different types of tyres:

Reduction factor for road wear from light-studded tyres compared to studded tyres: 0.7

Reduction factor for road wear from non-studded tyres compared to studded tyres: 0.05

A reduction factor of 0.7 indicate that it is expected that the road wear from light studded tyres is 70 % of the road wear from studded tyres.

It is a fact that the road wear is proportional to the weight of the stud. The road wear from non-studded tyres compared to studded tyres are not that well known. We suggest to use the values given above.

Do you want to use these numbers (Y/N)?

[If 'Y', go to 2.16. If 'N', go to 2.15.]

[2.15] **Ratio studded tyres (0.0-1.0):**
Ratio light-studded tyres (0.0-1.0):
Reduction in tyre wear from light-studded tyres (0.0-1.0):
Reduction in tyre wear from non-studded tyres (0.0-1.0):

It is possible for the user to give other values.

[2.16] **Effect of road cleaning on dust deposition and PM_{10}-concentrations:**
1.0 = no effect
0 = full effect

Do you want to use 1.0 (Y/N):

[If 'Y', go to 2.18. If 'N', go to 2.17.]

[2.17] **Factor for effect of cleaning (0.0-1.0):**

Observe that the question is not whether or not cleaning is performed, but what the effect of such a cleaning will be. The dust concentrations are multiplied with the given factor. The effect of cleaning has not been investigated in much detail, but it is included in the modell in case such knowlegde will appear.

[2.18] If file with building data are read, continue. If not, go to 2.20.

EXPOSURE:

Is the population exposure to pollution at residential units to be calculated (Y/N)?

[If 'Y', go to 2.19. If 'N', go to 2.20.]

[2.19] **Name of result file for exposure:**

Number of persons per residential unit:

The building file contains the number of housing units. In order to calculate the number of people exposed, an average number of persons per residential unit have to be given.

[2.20] **Writes to results file(s).**

Programme execution terminates and a listing of file names for the result files is given on the screen.

5. Results

The calculation results for normal road network calculations are presented in four separate files:

- emission file
- concentration file for maximum concentrations
- exposure file for maximum concentrations
- file with maximum concentrations at buildings.

For road junctions, the results are presented in one file only.

Classification of the pollution level along a road link is based on the ratio between the calculated maximum pollution concentrations at each link compared to the recommended air quality criteria given by the Norweigan State pollution Control Authority (SFT) (Table 8).

Table 8: Recommended air quality criteria for CO, NO_x and PM_{10} (SFT, 1992).

	CO mg/m3	PM_{10} µg/m3	NO_2 µg/m3
1-hour mean value	**25**	-	**100**
8-hour mean value	10	-	-
24-hour mean value	-	**70**	75

The emission file contains:

1. Date and time when the calculations were performed.

2. Year of calculation.

3. Name of file with road/traffic data.

4. Tables for emissions (tonnes/year) for the defined road network of CO, NO_x and CO_2, for different area types (densely, medium and sparsely built-up), and vehicle classes (light, heavy and buses). Potential additional emissions for roads outside the defined road network called low traffic roads.

5. Table for traffic work (vehicle km/24 hours) for different area types and light/heavy vehicles.

6. For each road link: emission of CO, NO_x and CO_2 in addition to traffic volume.

The concentration file contains:

1. Date and time when the calculations were performed.

2. Year of calculation.

3. Name of file with road/traffic data.

4. The background concentrations of CO, NO_2, PM_{10} and O_3 that are used.

5. Distance to point of calculation from curb for CO, NO_2 and PM_{10}.

6. Total length of road network and number of road links.

7. Number of tunnels and their respective lengths.

8. Tables with road lengths and number of road links with peak concentration above certain limits for CO, NO_2 and PM_{10}. These concentrations are valid for a chosen distance from curb and is uniform for the total road network. CO is compared to three different concentration levels, and NO_2 and PM_{10} are compared to eight levels.

9. Tables containing road length and number of road links for four classes of dust deposition and four classes of PM_{10} concentrations. These results are arranged according to area type.

10. Printout of the following parameters for each road link:
    - AADT
    - Concentrations levels of CO, NO_2 and PM_{10} at the chosen distance of calculation from curb.
    - Dust deposition class.
    - Distance from curb where the concentration exceeds 15 mg/m^3 for CO, 200 $\mu g/m^3$ for NO_2 and 200 $\mu g/m^3$ for PM_{10}. Tunnels are marked with -1.

    Distance "199" indicates that the distance of exceedance is greater than 100 m.

The exposure file contains:

1. Date and time when the calculations were performed.

2. Year of calculation.

3. Name of file with road/traffic data.

4. Name of file with building data.

5. The background concentrations of CO, NO_2, PM_{10} and O_3 that are used.

6. Number of persons per residential unit.

7. Total number of persons in the registered buildings. (This number is the number of persons per residential unit multiplied with the number of residental units registered in the building register.)

8. Table with the number of persons exceeding three, eight and eight concentration levels for CO, NO_2 and PM_{10}, respectively, for different area types.

9. Number of persons experiencing nuisance for different area types.

10. Printout of number of persons exceeding three, three and four concentration levels for CO, NO_2 and PM_{10}, respectively, for each road link. Number of people experiencing nuisance.

11. Equivalent to points 7-10 for persons in institutional buildings.

The file for all building units contains:

1. Date and time when the calculations were performed.

2. Year of calculation.

3. Name of file with road/traffic data.

4. For each building, a printout of the following parameters:
   - road link number and road identification
   - number of residential units or institutional buildings
   - concentrations of CO, NO_2 and PM_{10}. Based on programme technical reasons these are given with one decimal accuracy, although this is not reasonable based on the uncertainty factor in the calculations
   - number of persons experiencing nuisance.

The road junction file contains:

1. Date and time when the calculations were performed.

2. Year of calculation.

3. Name of file with road/traffic data.

4. The background concentrations of CO, NO_2, PM_{10} and O_3 that are used.

5. Distance to point of calculation from curb for CO, NO_2 and PM_{10}.

6. Total emissions of CO, NO_2 and PM_{10} (g/s) from the traffic in the road junction.

7. Concentrations of CO, NO_2 and PM_{10} as a function of distance from the fringes of the road junction (every 5th meter out to a distance of 100 meters).

Example of result files are shown on the following pages.

```
*****************************************************
*                 --  ROADAIR 3.11  --               *
*                                                    *
*          A program for calculation of air          *
*                                                    *
*       pollution parameters for road networks.      *
*                                                    *
*                                                    *
*                                                    *
*          -  VERSION 3.11 - November 1995  -        *
*****************************************************
```

RUN 11/ 4/1996 kl. 19.52.

EMISSION CALCULATIONS :

YEAR OF CALCULATION .....: 2005
FILE CONTAINING ROAD- AND TRAFFIC DATA ....: d9301271.txt

EMISSIONS OF CO, NOx AND CO2 (TONNES/YEAR), FOR EACH VEHICLE CLASS AND AREA TYPE.

EMISSIONS OF CO (carbon monoxide), TONNES/YEAR :

	SCATTERED	MEDIUM	DENSE	TOTAL
LIGHT DUTY	22.8	171.2	76.5	270.5
HEAVY DUTY	1.9	6.5	3.2	11.6
BUSES	.0	.0	.0	.0
TOTAL	24.7	177.7	79.7	282.0
LOW TRAFFIC R.	.0	.0	.0	.0
TOTAL	24.7	177.7	79.7	282.0

EMISSIONS OF NOx (nitrogen oxides), TONNES/YEAR:

	SCATTERED	MEDIUM	DENSE	TOTAL
LIGHT DUTY	6.6	21.1	7.7	35.3
HEAVY DUTY	5.1	14.7	5.9	25.7
BUSES	.0	.0	.0	.0
TOTAL	11.6	35.8	13.6	61.0
LOW TRAFFIC R.	.0	.0	.0	.0
TOTAL	11.6	35.8	13.6	61.0

EMISSIONS OF CO2 (carbon dioxide), TONNES/YEAR:

	SCATTERED	MEDIUM	DENSE	TOTAL
LIGHT DUTY	1273.7	3752.4	1570.3	6596.4
HEAVY DUTY	766.7	2300.8	881.4	3948.9
BUSES	.0	.0	.0	.0
TOTAL	2040.4	6053.3	2451.7	10545.3
LOW TRAFFIC R.	.0	.0	.0	.0
TOTAL	2040.4	6053.3	2451.7	10545.3

TRAFFIC ACTIVITY (VEH.KM/24 HOURS), BASED ON AADT
FOR EACH SPEED CLASS AND AREA TYPE

LIGHT DUTY	SCATTERED	MEDIUM	DENSE	TOTAL
0-10 km/h	0.	0.	0.	0.
10-20 km/h	0.	0.	0.	0.
20-30 km/h	0.	0.	0.	0.
30-40 km/h	0.	0.	0.	0.
40-50 km/h	0.	34619.	27998.	62616.
50-60 km/h	0.	0.	0.	0.
60-70 km/h	0.	0.	0.	0.
70-80 km/h	26312.	37481.	0.	63792.
> 80 km/h	0.	0.	0.	0.
TOTAL	26312.	72099.	27998.	126408.

HEAVY DUTY	SCATTERED	MEDIUM	DENSE	TOTAL
0-10 km/h	0.	0.	0.	0.
10-20 km/h	0.	0.	0.	0.
20-30 km/h	0.	0.	0.	0.
30-40 km/h	0.	0.	0.	0.
40-50 km/h	0.	3847.	3111.	6957.
50-60 km/h	0.	0.	0.	0.
60-70 km/h	0.	0.	0.	0.
70-80 km/h	2924.	4165.	0.	7088.
> 80 km/h	0.	0.	0.	0.
TOTAL	2924.	8011.	3111.	14045.
TOTAL	29235.	80110.	31109.	140454.

Emissions in tonnes/year for each link.

LNR	NAME	AADT	CO2	CO	NOx
Start					
1	E18	15000.	2040	24	11
2	E18	15000.	261	6	1
3	E18	7200.	1155	31	7
4	E18	17800.	1489	40	9
5	Strandveien	35000.	1714	52	8
6	Strandveien	35000.	1431	44	7
7	Prins Oscars gate	15000.	306	10	1
8	Engene	18500.	724	22	3
9	Engene	19400.	486	15	2
10	Haugesgate	18300.	170	5	1
11	Haugesgate	18300.	100	3	0
12	Haugesgate	18300.	143	4	0
13	Haugesgate	15800.	420	13	2
14	Haugesgate	15500.	97	2	0
Stop					

```
**************************************************
*                 --  ROADAIR 3.11  --           *
*                                                *
*          A program for calculation of air      *
*                                                *
*      pollution parameters for road networks.   *
*                                                *
*                                                *
*                                                *
*          -  VERSION 3.11 - November 1995  -    *
**************************************************
```

RUN 11/ 4/1996 kl. 19.52.

CONCENTRATION CALCULATIONS:

YEAR OF CALCULATION.....: 2005
FILE CONTAINING ROAD- AND TRAFFIC DATA...: d9301271.txt

BACKGROUND CONCENTRATIONS USED IN THE CALCULATIONS :

CO - dense (mg/m3) .....:	6.4
CO - medium (mg/m3) .....:	4.0
CO - scattered (mg/m3) .....:	1.0
NO2 - dense (ug/m3) .....:	39.0
NO2 - medium (ug/m3) .....:	25.0
NO2 - scattered (ug/m3) .....:	5.0
PM10 - dense (ug/m3) .....:	100.0
PM10 - medium (ug/m3) .....:	50.0
PM10 - scattered (ug/m3) .....:	30.0
Regional ozon (ug/m3) .....:	60.0

Distance from curb (m)
for concentrations of
CO, NO2 og PM10.....: 5.0

MAXIMUM CONCENTRATIONS OF CO, NO2, PM10 AND DUST DEPOSITION ARE CALCULATED
FOR A TOTAL OF 8.6 KM OF ROADS, DIVIDED IN 14 ROAD LINKS.

OF THE HEAVIEST POLLUTED ROAD LINKS ARE 1 LINKS TUNNELS, OF A TOTAL LENGTH OF 1.2 KM.
THESE ARE ALWAYS CLASSIFIED IN THE HEAVIEST POLLUTION CLASS FOR ALL COMPONENTS.

Number of road links and total road length for which different concentration limits for CO, NO2 and PM10 are exceeded:

	CO Km	CO road links		NO2 Km	NO2 road links
> 25 mg/m3:	1.2	1	> 400 ug/m3:	1.2	1
> 15 mg/m3:	1.2	1	> 350 ug/m3:	1.2	1
> 8 mg/m3:	4.1	11	> 320 ug/m3:	1.2	1
> 0 mg/m3:	8.6	14	> 280 ug/m3:	1.2	1
			> 240 ug/m3:	1.2	1
			> 200 ug/m3:	1.2	1
			> 150 ug/m3:	1.2	1
			> 100 ug/m3:	8.6	14
			> 0 ug/m3:	8.6	14

	PM10 Km	PM10 road links
> 400 ug/m3:	1.2	1
> 350 ug/m3:	1.2	1
> 300 ug/m3:	1.2	1
> 250 ug/m3:	1.2	1
> 200 ug/m3:	1.2	1
> 150 ug/m3:	1.2	1
> 100 ug/m3:	6.3	13
> 70 ug/m3:	8.6	14
> 0 ug/m3:	8.6	14

ROAD LENGTH (KM) FOR 4 DUST DEPOSITION CLASSES:

	SCATTERED	MEDIUM	DENSE	TOTAL
SEVERE DUST LOAD	1.9	4.8	1.1	7.9
HIGH DUST LOAD	.0	.0	.7	.7
MEDIUM DUST LOAD	.0	.0	.0	.0
LOW DUST LOAD	.0	.0	.0	.0
TOTAL	1.9	4.8	1.8	8.6

NUMBER OF ROAD LINKS FOR 4 DUST DEPOSITION CLASSES:

	SCATTERED	MEDIUM	DENSE	TOTAL
SEVERE DUST LOAD	1.0	5.0	5.0	11.0
HIGH DUST LOAD	.0	.0	3.0	3.0
MEDIUM DUST LOAD	.0	.0	.0	.0
LOW DUST LOAD	.0	.0	.0	.0
TOTAL	1.0	5.0	8.0	14.0

ROAD LENGTH (KM) IN EACH OF THE 4 PM10-CLASSES :

	SCATTERED	MEDIUM	DENSE	TOTAL
> 300 ug/m3	.0	1.2	.0	1.2
200 - 300 ug/m3	.0	.0	.0	.0
150 - 200 ug/m3	.0	.0	.0	.0
0 - 150 ug/m3	1.9	3.6	1.8	7.4
TOTAL	1.9	4.8	1.8	8.6

NUMBER OF ROAD LINKS FOR EACH OF THE 4 PM10-CLASSES :

	SCATTERED	MEDIUM	DENSE	TOTAL
> 300 ug/m3	.0	1.0	.0	1.0
200 - 300 ug/m3	.0	.0	.0	.0
150 - 200 ug/m3	.0	.0	.0	.0
0 - 150 ug/m3	1.0	4.0	8.0	13.0
TOTAL	1.0	5.0	8.0	14.0

Printout for each link:

Concentration = calculated concentrations for given distance from curb,
CO in mg/m3, NO2 and PM10 in ug/m3.
Distance = distance from curb for exceedance of NO2-concentrations
> 200 ug/m3, PM10-concentration > 200 ug/m3 and
CO-concentration > 15 mg/m3.
199: The distance is more than 100 m from curb.
0: The distance is between 0 and 5 m from curb.
Dust = indicator for dust deposition (1-4).

LNR	NAME		Concentrations			Distance			Dust
		AADT	CO	NO2	PM10	CO	NO2	PM10	(1-4)
Start									
1	E18	15000.	4.0	104.	110.	0	0	0	4
2	E18	15000.	6.9	121.	130.	0	0	0	4
3	E18	7200.	5.4	102.	88.	0	0	0	4
4	E18	17800.	99.0	999.	999.	-1	-1	-1	4
5	Strandveien	35000.	13.3	149.	137.	0	0	0	4
6	Strandveien	35000.	13.3	149.	137.	0	0	0	4
7	Prins Oscars gate	15000.	10.1	124.	132.	0	0	0	3
8	Engene	18500.	10.8	130.	141.	0	0	0	4
9	Engene	19400.	9.9	124.	133.	0	0	0	4
10	Haugesgate	18300.	12.4	138.	149.	0	0	0	4
11	Haugesgate	18300.	10.5	126.	134.	0	0	0	4
12	Haugesgate	18300.	10.8	130.	141.	0	0	0	4
13	Haugesgate	15800.	10.2	125.	135.	0	0	0	3
14	Haugesgate	15500.	10.1	125.	134.	0	0	0	3
Stopp									

```
   ***************************************************
   *                 --  ROADAIR 3.11  --             *
   *                                                  *
   *          A program for calculation of air        *
   *                                                  *
   *      pollution parameters for road networks.     *
   *                                                  *
   *                                                  *
   *                                                  *
   *         -  VERSION 3.11 - November 1995  -       *
   ***************************************************


RUN   11/ 4/1996   kl. 19.52.


EXPOSURE CALCULATIONS :

YEAR OF CALCULATIONS: .....................: 2005
FILE CONTAINING ROAD- AND TRAFFIC DATA .....: d9301271.txt
FILE CONTAINING BUILDING DATA ..............: d930127b.txt

BACKGROUND CONCENTRATIONS USED IN THE CALCULATIONS :

 CO   - dense (mg/m3) ..........:          6.4
 CO   - medium (mg/m3) .........:          4.0
 CO   - scattered (mg/m3) ......:          1.0
 NO2  - dense (ug/m3) ..........:         39.0
 NO2  - medium (ug/m3) .........:         25.0
 NO2  - scattered (ug/m3) ......:          5.0
 PM10 - dense (ug/m3) ..........:        100.0
 PM10 - medium (ug/m3) .........:         50.0
 PM10 - scattered (ug/m3) ......:         30.0
 Regional ozon (ug/m3) .........:         60.0

Distance from curb (m)
for concentrations of
CO, NO2 og PM10................:          5.0


*** PERSONS IN RESIDENTIAL UNITS ****************************************

CALCULATION OF POLLUTION EXPOSURE AT RESIDENCES:
(THE VALUES INCLUDES BACKGROUND POLLUTION.)

IT IS ASSUMED  2.40 PERSONS PER RESIDENTIAL UNIT WHICH GIVES   163
PERSONS TOTALLY IN THE REGISTERED BUILDINGS.

NUMBER OF PERSONS EXPOSED TO EXCEEDANCE OF 3 CONCENTRATION LEVELS FOR CO :
-----------------------------------------------------------------------

                    SCATTERED       MEDIUM        DENSE        TOTAL
>  25 mg/m3:               0.           0.           0.           0.
>  15 mg/m3:               0.           0.           0.           0.
>   8 mg/m3:               0.           0.         161.         161.
>   0 mg/m3:               0.           0.         163.         163.
=======================================================================


NUMBER OF PERSONS EXPOSED TO EXCEEDANCE OF 8 CONCENTRATION LEVELS FOR NO2 :
---------------------------------------------------------------------

                    SCATTERED       MEDIUM        DENSE        TOTAL
> 400 ug/m3:               0.           0.           0.           0.
> 350 ug/m3:               0.           0.           0.           0.
> 320 ug/m3:               0.           0.           0.           0.
> 280 ug/m3:               0.           0.           0.           0.
> 240 ug/m3:               0.           0.           0.           0.
> 200 ug/m3:               0.           0.           0.           0.
> 150 ug/m3:               0.           0.           0.           0.
> 100 ug/m3:               0.           0.         163.         163.
>   0 ug/m3:               0.           0.         163.         163.
=======================================================================
```

NUMBER OF PERSONS EXPOSED TO EXCEEDANCE OF 8 CONCENTRATION LEVELS FOR PM10 :

	SCATTERED	MEDIUM	DENSE	TOTAL
> 400 ug/m3:	0.	0.	0.	0.
> 350 ug/m3:	0.	0.	0.	0.
> 300 ug/m3:	0.	0.	0.	0.
> 250 ug/m3:	0.	0.	0.	0.
> 200 ug/m3:	0.	0.	0.	0.
> 150 ug/m3:	0.	0.	5.	5.
> 100 ug/m3:	0.	0.	163.	163.
> 70 ug/m3:	0.	0.	163.	163.
> 0 ug/m3:	0.	0.	163.	163.

NUMBER OF PERSONS EXPERIENCING NUISANCE FROM POLLUTION FOR EACH AREA TYPE AND TOTAL:

	SCATTERED	MEDIUM	DENSE	TOTAL
NUISANCED PERSONS:	0.	0.	34.	34.

Printout for each link:

-Number of persons exposed to exceedance of 3 limits for CO
-Number of persons exposed to exceedance of 4 limits for NO2
-Number of persons exposed to exceedance of 3 limits for PM10
-Number of persons experiencing nuisance from air pollution

LNR	Name/ref	CO >25	CO 25-15	CO 15-8	NO2 >400	NO2 399-350	NO2 349-200	NO2 199-100	PM10 >300	PM10 299-200	PM10 199-70	Pers.exp. nuisance
Start												
1	E18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	E18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3	E18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	E18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	Strandveien	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6	Strandveien	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
7	Prins Oscars gate	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
8	Engene	0.	0.	60.	0.	0.	0.	62.	0.	0.	62.	18.
9	Engene	0.	0.	5.	0.	0.	0.	5.	0.	0.	5.	1.
10	Haugesgate	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
11	Haugesgate	0.	0.	60.	0.	0.	0.	60.	0.	0.	60.	9.
12	Haugesgate	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
13	Haugesgate	0.	0.	29.	0.	0.	0.	29.	0.	0.	29.	4.
14	Haugesgate	0.	0.	7.	0.	0.	0.	7.	0.	0.	7.	1.
Stopp												

*** PERSONS IN INSTITUTIONS **

CALCULATIONS OF POLLUTION EXPOSURE IN INSTITUTIONS:
(THE VALUES INCLUDES BACKGROUND POLLUTION)

A TOTAL OF 0 PERSONS ARE REGISTRERED IN INSTITUTIONS IN THE REGISTRERED BUILDINGS.

NUMBER OF PERSONS EXPOSED TO EXCEEDANCE OF 3 CONCENTRATION LEVELS FOR CO :

	SCATTERED	MEDIUM	DENSE	TOTAL
> 25 mg/m3:	0.	0.	0.	0.
> 15 mg/m3:	0.	0.	0.	0.
> 8 mg/m3:	0.	0.	0.	0.
> 0 mg/m3:	0.	0.	0.	0.

NUMBER OF PERSONS EXPOSED TO EXCEEDANCE OF 8 CONCENTRATION LEVELS FOR NO2 :

	SCATTERED	MEDIUM	DENSE	TOTAL
> 400 ug/m3:	0.	0.	0.	0.
> 350 ug/m3:	0.	0.	0.	0.
> 320 ug/m3:	0.	0.	0.	0.
> 280 ug/m3:	0.	0.	0.	0.
> 240 ug/m3:	0.	0.	0.	0.
> 200 ug/m3:	0.	0.	0.	0.
> 150 ug/m3:	0.	0.	0.	0.
> 100 ug/m3:	0.	0.	0.	0.
> 0 ug/m3:	0.	0.	0.	0.

NUMBER OF PERSONS EXPOSED TO EXCEEDANCE OF 8 CONCENTRATION LEVELS FOR PM10 :

	SCATTERED	MEDIUM	DENSE	TOTAL
> 400 ug/m3:	0.	0.	0.	0.
> 350 ug/m3:	0.	0.	0.	0.
> 300 ug/m3:	0.	0.	0.	0.
> 250 ug/m3:	0.	0.	0.	0.
> 200 ug/m3:	0.	0.	0.	0.
> 150 ug/m3:	0.	0.	0.	0.
> 100 ug/m3:	0.	0.	0.	0.
> 70 ug/m3:	0.	0.	0.	0.
> 0 ug/m3:	0.	0.	0.	0.

NUMBER OF PERSONS EXPERIENCING NUISANCE FROM POLLUTION FOR EACH AREA TYPE AND TOTAL:

	SCATTERED	MEDIUM	DENSE	TOTAL
NUISANCED PERSONS:	0.	0.	0.	0.

Printout for each link:

-Number of persons exposed to exceedance of 3 limits for CO
-Number of persons exposed to exceedance of 4 limits for NO2
-Number of persons exposed to exceedance of 3 limits for PM10
-Number of persons experiencing nuisance from air pollution

LNR	Name/ref	CO >25	CO 25-15	CO 15-8	NO2 >400	NO2 399-350	NO2 349-200	NO2 199-100	PM10 >300	PM10 299-200	PM10 199-70	Pers.exp. nuisance
Start												
1	E18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	E18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3	E18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	E18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	Strandveien	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6	Strandveien	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
7	Prins Oscars gate	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
8	Engene	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
9	Engene	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
10	Haugesgate	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
11	Haugesgate	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
12	Haugesgate	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
13	Haugesgate	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
14	Haugesgate	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
Stopp												

```
*****************************************************
*                  --  ROADAIR 3.11  --              *
*                                                    *
*           A program for calculation of air         *
*                                                    *
*       pollution parameters for road networks.      *
*                                                    *
*                                                    *
*                                                    *
*          -  VERSION 3.11 - November 1995  -        *
*****************************************************

 RUN   11/ 4/1996   kl. 19.52.

 RESULTS FOR RESIDENTIAL UNITS :


 YEAR OF CALCULATION:.....................: 2005
 FILE CONTAINING ROAD- AND TRAFFIC DATA....: d9301271.txt
 FILE CONTAINING BUILDING DATA ............: d930127b.txt
```

LNR.. VK VN... HP KM....	HNR	ENR	NBO	NINST	Dist	CO-conc	NO2-conc	PM10-conc	Pers.exp. nuisance	ID
Start										
8 Engene	3	19	1	0	6	11.7	136.0	149.4	.72	0.
8 Engene	3	20	1	0	6	11.7	136.0	149.4	.72	0.
8 Engene	4	10	2	0	6	11.7	136.0	149.4	1.44	0.
8 Engene	4	21	1	0	6	11.7	136.0	149.4	.72	0.
8 Engene	4	14	1	0	6	11.7	136.0	149.4	.72	0.
8 Engene	4	15	1	0	6	11.7	136.0	149.4	.72	0.
8 Engene	5	9	1	0	16	9.1	117.9	125.2	.36	0.
8 Engene	5	18	3	0	6	11.7	136.0	149.4	2.16	0.
8 Engene	5	8	4	0	6	11.7	136.0	149.4	2.88	0.
8 Engene	5	7	2	0	6	11.7	136.0	149.4	1.44	0.
8 Engene	5	6	1	0	6	11.7	136.0	149.4	.72	0.
8 Engene	6	5	2	0	6	11.7	136.0	149.4	1.44	0.
8 Engene	6	4	1	0	50	7.4	105.7	109.0	.36	0.
8 Engene	6	3	2	0	6	11.7	136.0	149.4	1.44	0.
8 Engene	6	2	3	0	6	11.7	136.0	149.4	2.16	0.
9 Engene	1	8	2	0	6	12.0	137.8	151.8	1.44	0.
11 Haugesgate	1	2	1	0	8	11.5	132.3	142.3	.36	0.
11 Haugesgate	1	1	24	0	8	11.5	132.3	142.3	8.64	0.
13 Haugesgate	3	5	5	0	8	10.3	126.4	136.5	1.80	0.
13 Haugesgate	4	4	2	0	8	10.3	126.4	136.5	.72	0.
13 Haugesgate	4	3	1	0	8	10.3	126.4	136.5	.36	0.
13 Haugesgate	6	1	4	0	6	11.0	130.6	142.2	1.44	0.
14 Haugesgate	6	2	2	0	6	10.9	130.0	141.4	.72	0.
14 Haugesgate	6	1	1	0	6	10.9	130.0	141.4	.36	0.

6. Description of some of the programme modules

6.1 Structure of ROADAIR

ROADAIR is divided into several sub-models:

* gaseous emissions
* dispersion/concentration calculations
* generation of particles from roads
* background pollution
* exposure
* nuisance
* emission and dispersion from large road junctions.

Concentrations and exposure to CO and NO_2 are calculated on the basis of emissions, dispersion and background pollution. Road dust deposition is

calculated from traffic activity. Nuisance is calculated from NO_2 concentrations. The modules are thus interrelated.

The different sub-models are described briefly in the next sections. They are described in more detail in the programme documentation (Bekkestad et al., 1996).

6.2 Emissions

6.2.1 The defined main road network

The emission of CO and NO_x from the traffic at each link is calculated by multiplying the traffic activity (vehicles/hour) with the length of the link (km) and an emission factor (g/vehicle km).

For CO_2, the emission factor is estimated as gram emission per unit fuel, multiplied with the fuel consumption (kg/km). The emission factor for a road link is a function of:

- speed
- gradient
- year of calculation (because this indicates the level of technology)
- number of vehicles in different vehicle classes.

A correction for increased emissions from older cars and increased emissions for cars in cold start mode is included.

When calculating the total emission of CO, CO_2 and NO_x, the emission is calculated for the three area types separately, and is a function of speed and the ratio of heavy duty traffic. The following standard values for roads outside the defined road network are included in the programme (Table 9):

Table 9: Standard values for roads outside the defined road network for speed and heavy duty fraction.

		Speed (km/h)	*Ration of Heavy duty traffic*
Densely	*built – up area*	*40*	*2%*
Medium		*50*	*3%*
Sparsely		*70*	*5%*

6.2.2 Low traffic roads

A situation often encountered by the user of ROADAIR is the need to calculate the total emission from road traffic in a certain area (e.g. county) which consists of both urban and rural areas. Traffic data are usually generated by use of a traffic model, and there is usually a lower limit to the traffic activity required for a road to be included in the defined network. In other cases, only a certain category of roads will be included. ROADAIR offers the possibility of including emissions from roads not included in the network.

6.3 Chemistry of the atmosphere - NO_x and O_3

The NO_2 concentrations near the road is a sum of direct emissions of NO_2 from vehicles, NO that oxidize to NO_2 when reacting with ozone, and background concentrations of NO_2. Of these, the direct emission of NO_2 may be the most uncertain component. A lot of measurements of emissions of NO_x ($NO+NO_2$) have been performed, but there has been little interest in finding the NO_2 ratio. This is because the emission requirements are connected to NO_x.

6.4 Generation of suspended particles

6.4.1 What are suspended particles?

Pollution of particles along roads is a result of exhaust emissions and road dust particles from the road surface wear due to studded tyres.

The diameter of exhaust particles are usually in the range of 0.05-0.5 µm. The particles consist mainly of organic and inorganic carbon with a low content of heavy metals, except for lead and bromine when leaded gasoline is used. The exhaust particles are injurious to health because they contain organic compounds and sometime lead.

Particles generated from road dust are larger. The major part of the particles have diameter >10 µm (i.e. not possible to inhale). However, there is a considerable fraction of particles with diameter less than 10 µm and a small fraction with diameter even less than 2-3 µm.

When measuring, particles are divided into groups: greater/less than 2.5 µm. The fraction of particles less than 2.5 µm ($PM_{2.5}$) contains exhaust particles, and road dust when its dry. This fraction will penetrate to the lung alveolic when breathing.

The fraction between 2.5 µm and 10 µm ($PM_{2.5-10}$) consists mainly of road dust and is deposited in the upper respiratory tract (nose, mouth, throut and bronchia).

The total (the sum of $PM_{2.5}$ and $PM_{2.5-10}$) is called PM_{10}. For dry roads, PM_{10} is dominated by resuspended road dust. Exhaust particles dominate, when roads are wet. The PM_{10} concentration is then much less than for dry roads.

Suspended particles are calculated as PM_{10} in the model. The model calculates PM_{10} maximum 24-hour concentrations. The maximum will often occur at the end of the winter season (for countries with extended use of studded tyres) when the

roads dry up and the road dust deposit is at its maximum. The dust concentration depends on turbulence from vehicles, which depend on traffic activity, heavy duty traffic and speed.

6.5 Background pollution

6.5.1 The present situation

The pollution concentration along a given road equals the sum of the concentration due to emissions from the traffic along the given road in question and the background concentration.

The level of background concentration may be due to traffic in adjacent streets and roads, industrial sources, emissions from heating with oil, coal and firewood, and due to long range transport. The background levels of CO, NO_2 and PM_{10} have to be added to the estimated concentrations from the road. The background concentration of ozone contributes to the level of NO_2. Near streets with high traffic activity, the ozone-based NO_2 formation is mainly described by the following reaction:

$$NO + O_3 \rightarrow NO_2 + O_2$$

The background level of CO, NO_2 and PM_{10} will vary according to the degree of urbanization, as well as the dispersion conditions. The wind is of particular importance during the winter season. For towns and cities, the background pollution tends to decrease from the centre towards the outskirts. This is, however, not the situation for ozone which is due to long range transport. Therefore, the background level of ozone is the same throughout the city.

Table 10 below presents values suggested for maximum background concentration of CO, NO_2, PM_{10} and O_3 when calculating maximum concentrations in the vicinity of roads depending on area type and population. If measurements have been performed in the area of calculation, this may imply that the background levels should be modified. The background level of ozone is mainly due to long range transport. An ozone value of 60 $\mu g/m^3$ is recommended for the calculations for situations where no measurements of ozone are available.

Table 10: Recommended background pollution levels of CO, NO_2 and O_3 in Norway (hourly averages), and PM_{10} given as daily averages. The values depend on area type and population. (Present situation, 1990-95.)

Built-up area	Population		
	<50 000	50-200 000	>200 000
CO (mg/m3)			
Dense	4	7	11
Medium	3	4	7
Sparse	1	1	1
NO_2 (µg/m3)			
Dense	27	39	68
Medium	17	25	43
Sparse	5	5	5
PM_{10} (µg/m3)			
Dense	80	100	120
Medium	40	50	60
Sparse	30	30	30
O_3 (µg/m3)			
All area types	60	60	60

6.5.2 Future situation

Reduced specific emissions in combination with changes in traffic activity, will give altered background values for pollution in the future.

The changes are estimated from the following: the concentrations in Table 10 are multiplied with a factor k_s which is calculated from the equation given below:

$$k_s = \frac{(k_{red} \cdot k_{traf}) + a}{1 + a}$$

k_{red}: Emission reduction compared to today's level as a result of more stringent emission requirements and/or less studded tyres.

The values are taken from Table 11 and 12. If the ratio of non-studded tyres are 25% or less for the given calculation situation, then the standard values for background PM_{10} concentration in Table 10 can be used.

k_{traf}: The ratio of the total traffic activity (vehicle-km/24-hours) in the area for future years of calculation and todays situation.

a: The ratio between the contribution from other sources (i.e. not from vehicles) to background concentration, and the total background level. If there are no measurements of this value, a value of 0.2 is recommended.

Table 11: Relative reduction in emission factors for CO and NO_2 from traffic in the period 1993-2008. Linear interpolation is employed for calculating emission factors for intermediate years.

	k_{red}	
	CO	NO_2
1993	1,00	1,00
1998	0,73	0,80
2003	0,46	0,60
2008	0,18	0,40

Table 12: Relative reductions in background concentration levels of PM_{10} as a function of percentage non-studded tyres (k_{red}) for the year of calculation. Although the equations seem exact, they are rough estimates. A correction is performed only if the percentage of non-studded tyres exceeds 25%.

Persentage non-studded tyres	k_{red}, PM_{10}
$0.25 \leq a < 0.65$	$\frac{1-0.54a}{0.9}$
$0.65 \leq a \leq 1$	$\frac{0.65-1.57(a-0.65)}{0.9}$

It is assumed that the background level of ozone will remain at the same level in the near future, hence the value 60 µg/m³ is suggested for future calculations.

6.6 Exposure

ROADAIR calculates the number of residents in residential units close to the road that are exposed to various concentration levels of CO, NO_2 and PM_{10}. The calculations are performed at the outside of the buildings based on the distance between the road and the building facade. In the building register each building is allocated to the closest road, and only the concentration contribution from that road is considered.

For facade coverage 5 (special topography), the height between the base of the building and road is considered.

The building register includes data on number and residential units along each road link. The user gives the number of persons per residential unit as an average for all residential units.

6.7 Dispersion

Dispersion of emission from the traffic on a road results in a given concentration dependent on distance from the road and the dispersion conditions. ROADAIR calculates the absolute maximum pollution concentration that is expected to occur along the curb, when extremely poor dispersion conditions and rush hour traffic occur at the same time.

Concentrations are calculated in four different ways in the programme, dependent on the calculations to be performed, facade coverage, distance to point of calculation and if building registers are available.

"Road junction": The concentration contribution is calculated from an area source which contains the total emission from all given road links. Area source means that the emission takes places in a given area, in contradiction to a point source or a line source. For simplicity the area is defined to be 10 000 m^2. The contribution of the intersection to air pollution is calculated as a function of distance from the border of the intersection.

Ordinary road system: The concentrations are calculated using street canyon models if the facade coverage indicates so and the distance to point of calculation is less than 60 m. Buildings close to the road usually have no effect on pollution concentrations for distances greater than 60 m. The dispersion model for open roads is utilized. If the new OSPM model is to be used this requires that building data exist as the model includes building heights as input parameters. If there exist no building data, NBB (Nordisk Ministerråd, 1984) is used for dispersion calculations.

For open roads a line source model based on the EPA HIWAY 2-model is utilized.

6.8 "Nuisance"

The experience of nuisance due to air pollution along roads is due to the following factors:

* odour,
* particles from vehicle exhaust,
* road dust.

The relative importance of these three factors to the nuisance experienced by individuals cannot easily be described. Odour from exhaust will mainly be due to volatile organic compounds, coming from both diesel and gasoline combustion. Exhaust particle emissions come mainly from diesel vehicles. The generation and resuspension of road dust are mainly due to the heavy duty vehicle fraction of the traffic flow.

It should be noted that the nuisance calculations are valid for the dry winter situation in countries where studded tyres are used extensively. The model is based on NO_2 concentrations as an indicator of nuisance. The reason for this is

that both odour, exhaust particles and road dust particles is to a large extent due to heavy duty vehicles, which are also the main contributors to the NO_2 emissions. The quantitative connnection between NO_2 concentrations and the number of persons "severely bothered" is shown in Table 13. The numbers are based on results from the Traffic and Environment Project which was carried out in an area of Oslo with heavy traffic during the winter of 1991 (Transportøkonomisk institutt, 1991).

Table 13: Relationship between NO_2 concentrations and fraction of the population "severely bothered" by air pollution from traffic. The numbers are valid for the urban situation of 1991 in Oslo.

Interval for maximum 1-hr average NO_2 concentration	Percentage of exposed people being severely bothered
<35	0
35- 75	15
75-125	30
125-175	40
175-225	50
225-275	65
275-325	75
>325	

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ABSTRACT
ROADAIR is a PC based model calculating air pollution parameters in connection with road traffic. These are : Emission of CO, CO_2 and NO_x, concentrations of CO and NO_2, exposure to CO and NO_2, road dust deposition and "nuisance". Calculations are done for a whole network of roads. The programme is run interactively, and requires input files with data for traffic, roads, buildings, in specific formats.

NORWEGIAN TITLE Brukerveiledning for ROADAIR 3.1

KEYWORDS		
ROADAIR 3.11	User's Manual	Traffic pollution

ABSTRACT (in Norwegian)
ROADAIR er en PC-modell som beregner luftforurensning fra veitrafikk. Modellen beregner emisjon av CO, CO_2 og NO_x, konsentrasjon av CO og NO_2, eksponering for CO og NO_2, veistøv og "plagethet". Beregningene utføres for et helt veistystem. Programmet kjører interaktivt og krever innput-filer med data for trafikk, veier og bygninger i spesifikt format.

** Classification*
A Unclassified (can be ordered from NILU)
B Restricted distribution
C Classified (not to be distributed)