Norsk institutt for luftforskning
Norwegian Institute for Air Research

NOTE

To: :
From : Frederick Gram
Date : Kjeller, 28 October 1997
Ref.

KILDER Model System - Version 2.0, TR 12/96

Revision 2/97: October 1997

Enclosed you will find a set with corrections to the manual for the KILDER Model System, Version 2.0, NILU TR 12/96. Please change the pages with corresponding pages in your copy of the manual. The most important changes are listed in the Revision List below.

The license code for your programs is:____________

☐ You will also find an up-dated diskette with .EXE-versions of all the programs.

KILDER Model System, Version 2.0, Revisions list.

Revision	Date	Major changes
Revision 1/96	October 1996	Manual released
Revision 1/97	February 1997	Changes in some license codes. Errors in program description for METFREC Correction in CONS-EMI TRA-WORK, reading from a ROADAIR-file POI-KILD, format for stack data is not read New example for POI-EMIS Great changes in INP-FIE CODE-FIE new, adjusts fields according to area code fields RATI-FIE new, calculates the ratio between two fields
Revision 2/97	October 1997	POI-KILD, corrections to the manual POI-EMIS, changes to be more flexible Stability, page 4/5, corrections to Table 1 POPULATION, survey for population distribution DIST-POP, another program to distribute population TRA-WORK and TRA-EMIS, extended to 6 vehicle classes INP-FIE, major changes Errors, some error codes from the computer

Contents

POI-KILD, dispersion calculations for point sources

The program POI-KILD calculates sector averaged long term average concentrations at ground level in a grid of receptor points, with emission from several point sources, taking into account data on dispersion, topography, buildings and penetration through an upper stable layer.

Input data for POI-KILD

The program POI-KILD gets its input data from different sources; interactive from the terminal or from a RUN-file, from a file with **stack data**, and from a **MET-file** with meteorological data (described in a separate chapter). When you run the program for the first time it should be run interactive in order to get the correct answers to the questions. Later you may prepare a .RUN-file with all answers for the next calculations.

Stack-file INSTA

All **stack data** are read from the file INSTA (which should be of type .DAT). At this file all data which should remain constant are collected, while data which is varied from one run to another should be read interactive from a .RUN-file.

At the moment the program can handle 100 active point sources with emissions. This is mainly a question of using time and space in the program, and can easily be increased. If you have more than 100 sources, there is several ways to go:

- The computer automatic multiplies the lower limit for the emissions, QLIM by a factor of 2 until the number of sources is less than 100. The sources that are excluded in this way must be included as area sources.
- You make a run with the first 100 sources by puttine an END after source no. 100. In the next run the END is moved and the old sources is placed behind the END.
- The sources are grouped according the source group code ICOD. The first run may be made for source groups 1, 2 and 5, then for 3, 7, 8 and 9, and finally for the groups 4 and 6.
- If the point source file is created from the program POI-EMIS, the program can be run with other emission limits, moving small sources to the area emission file.
- At the end of the calculations you may have a lot of files with concentrations from different parts of the point sources, and these are summed by the program SUM-FIE.

The program POI-KILD does not give a dialogue when reading from the file INSTA, as the file is already prepared and the questions answered. Nevertheless, questions will be useful in preparing the file. The file is read until a line that begins with START or Start in columns 1-5. This means that we may put useful comments at the beginning of the file. The data at the file is read in different subroutines.

After the line with START the program reads:

TEXT	One line with a heading for the computations (A80)
ISIZE	Grid size in meter (integer).
UTMX, UTMY	Co-ordinates for south-west corner of the grid array (real).
ANORTH	Direction of the Y-axis (in degrees, counterclockwise, normally =0 (real).
NCOMP, ICO	Number of compounds with emission data ICO=0: standard compounds. 1=SO_2, 2=NO_x, 3=CO, 4=Particles ICO=1: new compounds

If ICO=1, the program reads new compound names.

(LCOMP(I), I=1,NCOMP)
The compound names (in apostrophes) (max. 6). The calculations are carried out for component no. ICOMP, which is read interactive, see page 4.

BACKG A background concentration of component no. ICOMP may be added to the result. For a composite calculation with different source groups the background should be added when making the sum of the data fields

TOP Do you want to correct for topography? Y/N

If TOP=Y, the program asks for

TOPFIL Name of the topography field (with apostrophes and .FLD)

DGR Standard ground level reflection factor ALPHA = 1.0 OK? Y/N

If DGR=N, the program asks for

ALPHA Ground level reflection factor, which is the relative amount of inert gas reflected from the surface by impaction. Can be used to estimate the effect of deposition on concentrations.

IDISP Selection of dispersion parameters:

1: McElroy-Pooler
2: Brookhaven
3: McElroy-Pooler for low sources, Brookhaven for high sources with effective stack height >HL (see later)
4: New values

If IDISP=3, it is possible to use different dispersion parameters for high and low sources. Standard limit between high and low sources = 50 m OK? Y/N.

If DHL=N, the program asks for

HL New limit for distinguishing between high and low sources. Sources with effective stack height >HL will use one set of dispersion parameters for high sources, other for low sources.

If IDISP=4, the program asks for new dispersion parameters:

SIGL
(CZL(I), I=1,4)
(PZL(I), I=1,4)

Name and dispersion parameters for low sources

$\sigma_z\ (low) = CZL \cdot X^{PZL}$

SIGH
(CZH(I), I=1,4)
(PZH(I), I=1,4)

Name and dispersion parameters for high sources

$\sigma_z\ (high) = CZH \cdot X^{PZH}$

JEM, ITT JEM=1: Emission in g/s
=2: Emission in kg/h
ITT =1: Temperature in degrees C
=2: Temperature in degrees K

The program reads two dummy lines with heading for the stack data, and then reads the stack data, until the end of the file. In the example file these lines are used to show the variable names, and the format. A line beginning with an asterisk (*) is not read by the program.

STACK,(SKOR(I), I=1,8), ICOD,(EM(I), I=1,ICOMP)

	Format: (A10,9F7.2,I2,6F7.2)
STACK	Stack (factory name) A10 (without apostrophes)
SKOR(1)	UTMX (km)
SKOR(2)	UTMY (km)
SKOR(3)	Stack base (m.a.s.l)
SKOR(4)	Stack height (m)
SKOR(5)	Stack diameter (m)
SKOR(6)	Gas temperature ° C or K, according to index ITT
SKOR(7)	Gas velocity (m/s)
SKOR(8)	Building height (default 10 m)
SKOR(9)	Building width (default 30 m)
ICOD	Source group code 1-9 (default=1),
EM	Emission data for max. 6 compounds, unit: see JEM. The calculations are performed with emission EM(ICOMP).

All data SKOR(1)-STACK(7) must be present, otherwise the program skips the source and gives a warning message.

For the building dimensions the program uses default height=10 m and width=30 m. For McElroy-Pooler dispersion parameters no building turbulence is calculated.

RUN-file or interactive input

C:\KILDER\POI-KILD

Starts the program when running it interactive.

C:\KILDER\POI-KILD <run-file.RUN

Starts the program from the run-file.RUN. It may be useful to use the same name for the RUN-file and OUTFI.

The run-file, or the answers to the interactive questions will be:

****	License code
KX, KY	Dimensions of the area, number of grid points easterly and northerly.
INSTA	Name of the INSTA file with stack data etc. (with apostrophes and .DAT). The main part of the input data is read from INSTA, but still some from the terminal.
OUTFI	Name of the output files (with apostrophes). The concentration data field is written binary (unformatted) to the file OUTFI.FLD, whereas the output from the program is written to the file OUTFI.PRN.
ICOMP	The calculations are carried out for component no. ICOMP, which is called COMPOUND=LCOMP(ICOMP).

Do you want to use all sources (1) or select groups (2). If 2, read:

NCOD, (IFACT(I), I=1,NCOD)

NCOD = number of source groups codes (max. 9).
IFACT = factors 0/1 for these.

It is possible to classify the sources at the file INSTA into source groups by the parameter ICOD at the stack file. By this we may include or exclude groups of sources in the calculations without changes in the file INSTA. This is useful especially when the sources are influenced by different dispersion conditions in different parts of the area. It is also possible to include different monthly emission figures at the stack file and select the correct set of emission data by the use of ICODE.
[Instead of using the idea of group codes some of the users of this program have preferred to enter the source list in the editor, rearrange it and move the sources which is not to be included to the top of the file, before START.]

It is possible to adjust the emission rates for some stacks without changing the data on the file:

NEMCH Number for emission figures which should be changed

If NEMCH > 0 the program asks for:

IZ, SCALE	Scale factor for source no. IZ
YNO	Is this source no. correct? Y/N If N, try again with a correct IZ

Only sources with emission rates different from zero are included in the further calculations. The numbering of a source is thus to some extent depending on what is done to the other sources higher up on the list.

The name of the MET-file is read from terminal/run-file

METFIL Name of the file with meteorological data (with apostrophes and .MET). See the separate description of this file.

YCON Finally the program asks if we want a survey of the contribution from each point source in selected grid points (max. 8): Y/N

If YCON=Y, program reads:

NPOINT, (IPO(I), JPO(I), I=1,NPOINT)

NPOINT Number of grid points (max. 8)

IPO(I), JPO(I)
I- and J-indices for each grid point.

Test example for POI-KILD

As a test example is used calculations for point sources in Grenland, Norway. The data for the sources are arranged a little.

The stack file GREPOINT.DAT will be:

```
START
POINT SOURCES IN GRENLAND
1000                 , Grid size
28,45                , Lower left corner
0,                   , North is north
N,                   , Not standard compounds
3,'SO2','NOx','Part', New compounds
0.0,                 , Background
N,                   , No correction for topography
Y,                   , Ground level reflection 1.0
3,                   , McElroy-Pooler for low sources, Brookhaven for high sources
Y,                   , Standard limit 50 m
2,1,                 , Emission in kg/h and temp. in deg. C
AAAAAAAAAAffff.ffFFFF.FFffff.ffFFFF.FFffff.ffFFFF.FFffff.ffFFFF.FFffff.ffiiFFFF.FFffff.ffFFFF.FF
* Source    X(km)  Y(km)   Z(m)   H(m)    D(m)   T(c)  V(m/s)  HB(m)   WB(m)Grp  SO2     NOX    Part
SENTRALSYK  34.00  61.90  20.00  25.00    0.60 220.00   1.00                 1  1.00    1.70   0.10
POLLY       34.30  62.30  10.00  15.00    0.64 205.00   2.90  12.00    50.00 1
*
* Source    X(km)  Y(km)   Z(m)   H(m)    D(m)   T(c)  V(m/s)  HB(m)   WB(m)Grp  SO2     NOX    Part
BORGESTAD   36.82  58.48   5.00  16.00    0.67 165.00  10.20  12.00    50.00 2          0.50
BORGESTAD   36.80  58.52   5.00  12.00    0.67 165.00   7.80  12.00    50.00 2          0.20
BORGESTAD   36.79  58.50   5.00  15.00    0.60  10.00   1.00  12.00    50.00 2  0.10    0.10
FJELDHAMME  38.70  54.50  75.00  20.00    1.00  60.00  15.60  15.00    30.00 2
*
* Source    X(km)  Y(km)   Z(m)   H(m)    D(m)   T(c)  V(m/s)  HB(m)   WB(m)Grp  SO2     NOX    Part
HY-RA-CRAC  34.17  51.05   5.00  50.00    1.80 215.00  13.00           31.00 3         41.30
HY-RA-ETYL  33.73  51.06   5.00  90.00    2.70 300.00   0.40                 3          1.10
HY-RA-KJEL  34.20  51.03   5.00  50.00    2.80 170.00  10.00                 3         17.60
HY-RA-VCMF  33.73  51.56   5.00  50.00    1.20 300.00   8.00                 3          7.60
HY-RA-EDC   33.73  51.30   5.00  35.00    0.50  15.00  10.00                 3          3.80
*
* Source    X(km)  Y(km)   Z(m)   H(m)    D(m)   T(c)  V(m/s)  HB(m)   WB(m)Grp  SO2     NOX    Part
SU-CELUF    34.98  62.98   5.00  40.00    2.00  70.00   7.10  30.00    50.00 5  6.00    7.90   4.40
DIFFUS      34.96  62.95   5.00  30.00                        30.00    50.00 5 13.00
FYRHUS      35.13  62.61   5.00  50.00    1.90  95.00   5.00                 5  4.30    3.10
*
* Source    X(km)  Y(km)   Z(m)   H(m)    D(m)   T(c)  V(m/s)  HB(m) WB(m) Grp   SO2     NOX    Part
LAND-DA1    36.07  53.47   5.0    38.0   30.0   10.0                         4  0.20    5.94
LAND-F1     35.74  53.67   5.0    58.0    1.8   24.0     5.5                 4          4.30   3.50
LAND-F17    35.48  54.06   5.0    50.0    1.6   45.0    13.0                 4                 5.30
LAND-F19    35.48  54.02   5.0    83.0    1.3   15.0    15.0                 4          9.90  12.40
LAND-F20    35.50  54.00   5.0    83.0    0.6   20.0    13.0                 4          0.66
LAND-F27    35.47  54.03   5.0    83.0   10.2   30.0    21.0                 4                 5.40
LAND-F29    35.47  54.02   5.0    83.0    0.8   40.0    22.0                 4                 3.60
LAND-F33    35.48  54.05   5.0    53.0    1.8   40.0     8.0                 4                 2.10
LAND-F61    35.52  54.01   5.0   115.0   11.4   30.0    20.0                 4                 5.80
LAND-KS-4   35.89  53.55   5.0    63.0    2.2   30.0    13.0                 4                 5.20
LAND-NH3F   35.96  54.32   5.0    20.0   50.0   20.0                         4  0.20   22.11
LAND-NO3F   36.02  53.60   5.0   100.0    3.0   20.0    18.0                 4         60.06
MAGN-Mg13   36.01  53.92   5.0    45.0    1.6   55.0     9.0                 4  1.00    3.40   0.50
MAGN-Mg4    36.00  53.83   5.0    42.0    2.0  190.0    11.0                 4  7.00    6.90   2.20
MAGN-Mg4D   36.42  53.54   5.0    72.0    1.6  300.0    18.5                 4  5.00    7.00  14.90
MAGN-S3     35.86  54.00   5.0   100.0    3.5   20.0     9.0                 4 13.10           4.50
```

The meteorology file GREN-WIN.MET will be:

```
WINTER-AVERAGE,             Period
GRENLAND,                   Place
-1.5,                       Average temp.
12,                         Number of sectors
1.0,3.2,4.9,7.1,            Wind speeds
10.0,                       Wind in 10 m
0.3,                        Starting velocity
Y,                          Standard wind profile exp.
N,                          Not standard inv.heights
700.0,500.0,300.0,300.0,    Inv. heights
  30 0.3 1.9 0.3 0.1 0.7 3.1 0.1 0.0 0.4 1.9 0.0 0.0 0.1 0.1 0.0 0.0
  60 0.7 6.5 4.7 5.5 3.1 8.4 1.6 0.9 0.8 1.0 0.3 0.1 0.0 0.1 0.0 0.0
  90 0.3 3.6 4.0 4.7 0.5 0.6 0.0 0.0 1.4 0.0 0.0 0.0 0.2 0.0 0.0 0.0
 120 0.2 0.9 0.8 0.9 0.0 0.5 0.0 0.0 1.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
 150 0.1 2.1 0.6 0.6 0.3 0.6 0.2 0.0 0.1 0.1 0.1 0.0 0.0 0.0 0.0 0.0
 180 0.5 2.7 0.5 0.3 0.5 2.0 0.1 0.0 0.8 2.4 0.1 0.0 0.7 1.5 0.0 0.1
 210 0.4 2.4 0.7 0.4 0.3 1.8 0.2 0.0 0.2 0.4 0.2 0.1 0.0 0.1 0.0 0.0
 240 0.2 1.5 1.2 0.1 0.1 0.3 0.0 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
 270 0.1 0.5 0.8 0.4 0.1 0.2 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
 300 0.1 0.3 0.3 0.2 0.0 0.2 0.0 0.0 0.0 0.1 0.0 0.0 0.0 0.0 0.0 0.0
 330 0.0 0.4 0.1 0.0 0.3 0.8 0.1 0.0 0.2 0.4 0.0 0.0 0.2 0.1 0.0 0.0
 360 0.0 0.1 0.0 0.0 0.1 0.7 0.1 0.0 0.3 1.0 0.0 0.0 0.1 0.1 0.0 0.0
     0.0 0.8 0.9 1.1,     Calm
```

The result will be found at the file POI-GREN.PRN:

```
Norwegian institute for air research (NILU)
  "KILDER" program package license for
        NILU
         VERSION 2.0, 1-10-1996
         - - - - O O O - - - -

Welcome to the program POI-KILD, for calculating
long-term mean values from a number of point sources.

The source POLLY      has no emission  and is not included.
The source FJELDHAMME has no emission  and is not included.
The source DIFFUS     has no emission  and is not included.
Stack data for LAND-DA1  are not complete:  36.07  53.47    5.00  38.00  30.00  10.00   .00
                          and the source is not included.
The source LAND-F17   has no emission  and is not included.
The source LAND-F27   has no emission  and is not included.
The source LAND-F29   has no emission  and is not included.
The source LAND-F33   has no emission  and is not included.
The source LAND-F61   has no emission  and is not included.
The source LAND-KS-4  has no emission  and is not included.
Stack data for LAND-NH3F are not complete:  35.96  54.32    5.00  20.00  50.00  20.00   .00
                          and the source is not included.
The source MAGN-S3    has no emission  and is not included.
Sum emission from   2 sources without complete data:    28.05 kg/h
Remember to include these as area sources!!
10 sources with no emissions

    POINT SOURCES IN GRENLAND
    Stack data are read from file............ GREPOINT.DAT
    Computations are made for................ NOx
    Ground level reflection factor ALPHA...... 1.000
    The concentration are ground level values with 30o sector averages
    The SW corner of the area has coordinates (  28.00,  45.00)
    The centre of grid (1,1) has the local coordinates ( .50, .50)
    Dispersion parameters from McElroy-Pooler for low sources,
                               Brookhaven     for elevated sources (above  50. meters)
```

Frequency matrix for WINTER-AVERAGE, in GRENLAND, is read from file GREN-WIN.MET

	1.0m/s				3.2m/s				4.9m/s				7.1m/s			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
30	.3	2.0	.3	.1	.7	3.1	.1	.0	.4	1.9	.0	.0	.1	.1	.0	.0
60	.7	6.7	5.0	6.0	3.1	8.4	1.6	.9	.8	1.0	.3	.1	.0	.1	.0	.0
90	.3	3.7	4.3	5.1	.5	.6	.0	.0	1.4	.0	.0	.0	.2	.0	.0	.0
120	.2	.9	.9	1.0	.0	.5	.0	.0	1.0	.0	.0	.0	.0	.0	.0	.0
150	.1	2.2	.6	.7	.3	.6	.2	.0	.1	.1	.1	.0	.0	.0	.0	.0
180	.5	2.8	.5	.3	.5	2.0	.1	.0	.8	2.4	.1	.0	.7	1.5	.0	.1
210	.4	2.5	.7	.4	.3	1.8	.2	.0	.2	.4	.2	.1	.0	.1	.0	.0
240	.2	1.6	1.3	.1	.1	.3	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0
270	.1	.5	.9	.4	.1	.2	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0
300	.1	.3	.3	.2	.0	.2	.0	.0	.0	.1	.0	.0	.0	.0	.0	.0
330	.0	.4	.1	.0	.3	.8	.1	.0	.2	.4	.0	.0	.2	.1	.0	.0
360	.0	.1	.0	.0	.1	.7	.1	.0	.3	1.0	.0	.0	.1	.1	.0	.0

Stability	1	2	3	4
Windprof.exponent	.20	.28	.36	.42
Mixing height	700.	500.	300.	300.

The wind speed in the lowest wind speed group is adjusted for calm from 1.00 m/s to .96 m/s
All point sources are included

Number of sources........................... 18
Default building dimensions:...........HEIGHT=10m
WIDTH=30m

Source data:

	Name	Relative coordinates X	Relative coordinates Y	Stack base m	Stack height m	Stack diameter m	Gas temp. oC	Exit velocity m/s	Building height m	Building width m	NOx emission kg/h
1	SENTRALSYK	6.00	16.90	20.00	25.0	.60	220.	1.0	10.	30.	1.70
2	BORGESTAD	8.80	13.50	5.00	16.0	.67	165.	10.2	12.	50.	.50
3	BORGESTAD	8.80	13.50	5.00	12.0	.67	165.	7.8	12.	50.	.20
4	BORGESTAD	8.80	13.50	5.00	15.0	.60	10.	1.0	12.	50.	.10
5	HY-RA-CRAC	6.17	6.05	5.00	50.0	1.80	215.	13.0	10.	31.	41.30
6	HY-RA-ETYL	5.73	6.06	5.00	90.0	2.70	300.	.4	10.	30.	1.10
7	HY-RA-KJEL	6.20	6.03	5.00	50.0	2.80	170.	10.0	10.	30.	17.60
8	HY-RA-VCMF	5.73	6.56	5.00	50.0	1.20	300.	8.0	10.	30.	7.60
9	HY-RA-EDC	5.73	6.30	5.00	35.0	.50	15.	10.0	10.	30.	3.80
10	SU-CELU	6.98	17.98	5.00	40.0	2.00	70.	7.1	30.	50.	7.90
11	FYRHUS	7.13	17.61	5.00	50.0	1.90	95.	5.0	10.	30.	3.10
12	LAND-F1	7.74	8.67	5.00	58.0	1.80	24.	5.5	10.	30.	4.30
13	LAND-F19	7.48	9.02	5.00	83.0	1.30	15.	15.0	10.	30.	9.90
14	LAND-F20	7.50	9.00	5.00	83.0	.60	20.	13.0	10.	30.	.66
15	LAND-NO3F	8.02	8.60	5.00	100.0	3.00	20.	18.0	10.	30.	60.06
16	MAGN-Mg13	8.01	8.92	5.00	45.0	1.60	55.	9.0	10.	30.	3.40
17	MAGN-Mg4	8.00	8.83	5.00	42.0	2.00	190.	11.0	10.	30.	6.90
18	MAGN-Mg4D	8.42	8.54	5.00	72.0	1.60	300.	18.5	10.	30.	7.00
										SUM	177.12

Norwegian institute for air research (NILU)
"KILDER" program package license for
NILU
VERSION 2.0, 1-10-1996
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MAP OF : NOx UNIT: UG/M3 SOURCE: POINT SOURCES
PERIOD : WINTER-AVERAGE PLACE: GRENLAND GRID SIZE: 1000 METER
CREATED: 1996/09/10 09.46
MAXIMUM VALUE IS 5.6226E+00, IN (5, 8)
SUM= 3.10635E+02 SCALE FACTOR: 1.0E-03

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
J=20	431.	350.	388.	468.	501.	710.	718.	863.	608.	632.	574.	494.	461.	410.	379.	355.
J=19	495.	547.	616.	752.	744.	749.	943.	729.	708.	659.	578.	497.	463.	434.	404.	379.
J=18	598.	680.	794.	1038.	895.	1841.	4533.	792.	715.	684.	582.	542.	506.	469.	436.	406.
J=17	620.	851.	1010.	1430.	1899.	3725.	1217.	920.	809.	730.	616.	578.	534.	509.	471.	426.
J=16	757.	960.	1137.	1407.	1361.	926.	977.	942.	939.	823.	677.	629.	581.	535.	480.	373.
J=15	791.	900.	1118.	1021.	861.	832.	997.	1061.	1040.	979.	757.	693.	633.	558.	420.	365.
J=14	781.	875.	769.	691.	907.	948.	1008.	1403.	1829.	928.	838.	760.	667.	489.	419.	383.
J=13	771.	678.	560.	616.	979.	1075.	1082.	1726.	1387.	1002.	921.	800.	565.	487.	444.	403.
J=12	580.	545.	605.	668.	783.	1114.	1174.	1771.	1525.	1118.	958.	649.	557.	509.	462.	419.
J=11	1069.	764.	631.	698.	751.	1088.	1194.	1373.	1686.	1121.	713.	618.	579.	499.	436.	317.
J=10	1091.	1211.	1342.	1500.	1566.	1551.	1260.	1099.	1163.	675.	560.	448.	418.	386.	352.	319.
J= 9	1100.	1223.	1354.	1479.	1513.	1713.	2937.	2041.	555.	465.	470.	453.	425.	377.	341.	257.
J= 8	1763.	1345.	1553.	2002.	3072.	4012.	4081.	1320.	653.	385.	369.	346.	300.	309.	281.	256.
J= 7	2467.	2828.	3149.	3546.	4092.	3942.	1468.	530.	486.	447.	294.	275.	250.	225.	202.	182.
J= 6	2433.	2694.	3239.	3962.	5623.	2623.	1234.	354.	345.	380.	371.	267.	244.	220.	198.	179.
J= 5	3100.	3517.	3991.	4234.	2241.	1332.	909.	402.	258.	270.	247.	224.	223.	212.	192.	174.
J= 4	2920.	3274.	3445.	1923.	1194.	835.	680.	314.	284.	234.	218.	200.	180.	135.	123.	114.
J= 3	2719.	2842.	1663.	884.	977.	609.	268.	248.	232.	221.	192.	178.	163.	148.	116.	107.
J= 2	2371.	1400.	702.	754.	721.	451.	209.	201.	191.	183.	188.	159.	147.	135.	124.	101.
J= 1	1179.	565.	603.	648.	609.	377.	152.	158.	160.	151.	163.	152.	133.	123.	114.	105.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Results are printed to file POI-GREN.PRN
Concentrations are put on file POI-GREN. FLD

```
PLUME RISE STATISTICS
  Plume rise, and index:
    1: No building turbulence
    2: Building turbulence  (He>0.5 Hb)
    3: Trapped by buildings (He=0.5 Hb)
       should this source be included in the area sources?
   -1: No occurrence of the stability/wind speed class

                     .96 M/S                      3.20 M/S                      4.90 M/S                      7.10 M/S
   SOURCE       1       2       3       4       1       2       3       4       1       2       3       4       1       2       3       4
 SENTRALSYK    34. 1   33. 1   43. 1   40. 1   25. 2   25. 2   35. 2   32. 2   24. 2   23. 2   33. 2   31. 2   23. 2   23. 2    0.-1   30. 2
 BORGESTAD     76. 1   74. 1   61. 1   53. 1   26. 2   25. 2   38. 2   32. 2   18. 2   17. 2   32. 2   27. 2    6. 3    6. 3    0.-1    6. 3
 BORGESTAD     64. 1   63. 1   55. 1   47. 1    6. 3    6. 3    6. 3    6. 3    6. 3    6. 3    6. 3    6. 3    6. 3    6. 3    0.-1    6. 3
 BORGESTAD     16. 1   16. 1   24. 1   22. 1    6. 3    6. 3    6. 3    6. 3    6. 3    6. 3    6. 3    6. 3    6. 3    6. 3    0.-1    6. 3
 HY-RA-CRAC   335. 1  300. 1  137. 1  120. 1  135. 1  125. 1  108. 1   97. 1  106. 1   99. 1  100. 1   90. 1   88. 1   83. 1    0.-1   84. 1
 HY-RA-ETYL   122. 1  116. 1  118. 1  111. 1   94. 1   92. 1  106. 1  101. 1   90. 1   89. 1  102. 1   98. 1   87. 1   86. 1    0.-1   96. 1
 HY-RA-KJEL   438. 1  360. 1  152. 1  132. 1  166. 1  152. 1  118. 1  105. 1  126. 1  116. 1  107. 1   95. 1  100. 1   93. 1    0.-1   88. 1
 HY-RA-VCMF   172. 1  158. 1  110. 1   98. 1   87. 1   82. 1   90. 1   81. 1   73. 1   70. 1   83. 1   76. 1   65. 1   63. 1    0.-1   72. 1
 HY-RA-EDC     47. 1   46. 1   53. 1   49. 1   39. 1   38. 1   47. 1   45. 1   37. 1   36. 1   45. 1   43. 1   36. 1   35. 1    0.-1   42. 1
 SU-CELUF     166. 1  153. 1  101. 1   89. 1   53. 2   48. 2   15. 3   15. 3   15. 3   15. 3   15. 3   15. 3   15. 3   15. 3    0.-1   15. 3
 FYRHUS       152. 1  139. 1  105. 1   94. 1   79. 1   75. 1   84. 1   77. 1   67. 1   64. 1   78. 1   72. 1   60. 1   58. 1    0.-1   68. 1
 LAND-F1      100. 1   95. 1   95. 1   88. 1   70. 1   67. 1   81. 1   75. 1   64. 1   62. 1   76. 1   72. 1   60. 1   59. 1    0.-1   69. 1
 LAND-F19     123. 1  117. 1  118. 1  111. 1   95. 1   93. 1  106. 1  102. 1   91. 1   90. 1  103. 1   98. 1   88. 1   86. 1    0.-1   96. 1
 LAND-F20      99. 1   96. 1  105. 1  100. 1   88. 1   87. 1   97. 1   94. 1   86. 1   85. 1   95. 1   92. 1   84. 1   84. 1    0.-1   91. 1
 LAND-NO3F    277. 1  247. 1  174. 1  164. 1  153. 1  144. 1  146. 1  136. 1  135. 1  129. 1  140. 1  131. 1  124. 1  119. 1    0.-1  125. 1
 MAGN-Mg13    136. 1  126. 1   97. 1   87. 1   72. 1   69. 1   80. 1   73. 1   62. 1   60. 1   74. 1   68. 1   56. 1   54. 1    0.-1   64. 1
 MAGN-Mg4     331. 1  300. 1  130. 1  113. 1  129. 1  119. 1  101. 1   89. 1   99. 1   93. 1   92. 1   82. 1   80. 1   75. 1    0.-1   76. 1
 MAGN-Mg4D    392. 1  337. 1  163. 1  145. 1  168. 1  154. 1  133. 1  121. 1  135. 1  126. 1  125. 1  114. 1  115. 1  109. 1    0.-1  108. 1
```

SENTRALSYK, BORGESTAD and SU-CELUF are all influenced by buildings plume rise index 2 or 3. First, you must control the building and stack data.

```
PENETRATION
 SENTRALSYK  .00 1  .00 1  .00 1  .00 1  .00 2  .00 2  .00 2  .00 2  .00 2  .00 2  .00 2  .00 2  .00 2  .00 2  .00-1  .00 2
 BORGESTAD   .00 1  .00 1  .00 1  .00 1  .00 2  .00 2  .00 2  .00 2  .00 2  .00 2  .00 2  .00 2  .00 3  .00 3  .00-1  .00 3
 BORGESTAD   .00 1  .00 1  .00 1  .00 1  .00 3  .00 3  .00 3  .00 3  .00 3  .00 3  .00 3  .00 3  .00 3  .00 3  .00-1  .00 3
 BORGESTAD   .00 1  .00 1  .00 1  .00 1  .00 3  .00 3  .00 3  .00 3  .00 3  .00 3  .00 3  .00 3  .00 3  .00 3  .00-1  .00 3
 HY-RA-CRAC  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00-1  .00 1
 HY-RA-ETYL  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00-1  .00 1
 HY-RA-KJEL  .00 1  .18 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00-1  .00 1
 HY-RA-VCMF  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00-1  .00 1
 HY-RA-EDC   .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00-1  .00 1
 SU-CELUF    .00 1  .00 1  .00 1  .00 1  .00 2  .00 2  .00 3  .00 3  .00 3  .00 3  .00 3  .00 3  .00 3  .00 3  .00-1  .00 3
 FYRHUS      .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00-1  .00 1
 LAND-F1     .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00-1  .00 1
 LAND-F19    .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00-1  .00 1
 LAND-F20    .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00-1  .00 1
 LAND-NO3F   .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00-1  .00 1
 MAGN-Mg13   .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00-1  .00 1
 MAGN-Mg4    .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00-1  .00 1
 MAGN-Mg4D   .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00 1  .00-1  .00 1
```

The mixing heights are so high that we have no plume penetration.

SOURCE CONTRIBUTIONS:

	EMISSION	5, 6	12, 4	10,13	7,18
SENTRALSYK	1.700	8.7264E-04	1.1724E-03	4.0036E-03	4.4211E-01
BORGESTAD	.500	2.6837E-03	5.3472E-04	1.0625E-02	7.8157E-03
BORGESTAD	.200	1.0865E-03	2.2257E-04	5.0195E-03	3.8581E-03
BORGESTAD	.100	5.4312E-04	1.1592E-04	3.1540E-03	2.0516E-03
HY-RA-CRAC	41.300	1.0497E+00	3.7026E-02	1.5739E-01	1.1991E-01
HY-RA-ETYL	1.100	1.0243E-01	1.6180E-03	7.0971E-03	4.4771E-03
HY-RA-KJEL	17.600	2.7220E-01	1.1566E-02	4.9658E-02	4.1315E-02
HY-RA-VCMF	7.600	5.4088E-01	1.0568E-02	4.9968E-02	3.2355E-02
HY-RA-EDC	3.800	1.6946E+00	1.0756E-02	3.1700E-02	1.8166E-02
SU-CELUF	7.900	3.4130E-03	4.1394E-03	1.4501E-02	3.3757E+00
FYRHUS	3.100	1.4113E-03	1.6301E-03	7.2120E-03	8.3573E-02
LAND-F1	4.300	2.5522E-01	9.3507E-03	7.3742E-02	2.9249E-02
LAND-F19	9.900	1.2031E-01	1.6752E-02	1.4395E-01	6.2539E-02
LAND-F20	.660	8.8935E-03	1.2132E-03	1.1146E-02	4.4826E-03
LAND-NO3F	60.060	1.1306E+00	7.0954E-02	3.1311E-01	2.3196E-01
MAGN-Mg13	3.400	1.6702E-01	6.8420E-03	5.5864E-02	2.2469E-02
MAGN-Mg4	6.900	1.6520E-01	8.6064E-03	3.9312E-02	2.8208E-02
MAGN-Mg4D	7.000	1.0552E-01	7.2713E-03	2.4591E-02	2.2419E-02
	SUM	5.6226E+00	2.0034E-01	1.0021E+00	4.5327E+00

The sources HY-RA-CRAC, HY-RA-EDC and LAND-NO3F gives the highest contributions in (5,6), while SU-CELUF is most important in (7,18).

Program POI-EMIS

In the program POI-KILD we calculate concentrations from point sources. All informations about the point sources (name, position, stack parameters and emissions) are collected in a **stack-file** INSTA, see the description for POI-KILD.

In some cases we start with informations about activity data as **fuel consumption** or **production** instead of emission data. The program POI-EMIS is prepared as a tool for calculating average hourly emissions from such consumption data, especially when we have a series of different consumption data sets. For this you have to prepare a stack-file INSTA as described for POI-KILD, see also the example to this.

In POI-EMIS the stack-file INSTA is read and copied to a new stack-file OUTFI.DAT until two dummy lines preceding the source data. Some of the information on the file is used by POI-EMIS, but most of it is only for POI-KILD. For each source the emissions are calculated, using consumption data, period length and emission factors. The program uses the same emission factor file as in CONS-EMI, see the separate description of this. If the emissions of all the compounds are less than given limits, the emissions are collected in an **area source** file OUTFI.FLD and OUTFI.PRN. Otherwise they are written together with the other source data to OUTFI.DAT, according to the POI-KILD format.

The fuel consumption data may be for a year or a shorter period, and the program calculates the average emission rate kg/h.

Input data to POI-EMIS

KX, KY, NCOMP	Grid dimensions, number of points eastward and northward and number of compounds (max 6)
INSTA	Input file with stack and consumption data (with apostrophes and .DAT)
OUTFI	Name of the output files (with apostrophes) Stack data and point source emissions are written to OUTFI.DAT The area emission fields (if any) will be written binary to the file OUTFI.FLD, the output is written to the file OUTFI.PRN
PERIOD, PLACE	Both with apostrophes
ICON	We may have different sets with consumption data at the file (max. 5), we want to use no. ICON
NDAY	Number of days in the data period
INFAK	Emission factors are read from INFAK (with apostrophes and .DAT).
(QLIM(I), I=1,NCOMP)	Limits for point source emissions (kg/h)

Consumption data

The preliminary stack-file INSTA contains both data about the stack and the consumption or other activity. If the calculated emissions from a source are small, the source will be included as an area source and the detailed stack information is not necessary. Instead of the line with
STACK, (SKOR(I), I=1,8), ICOD, (EM(I), I=1 NCOMP),
the program reads
STACK, (SKOR(I), I=1, 2), SKORTE, ICOD, IFU, (CON(I), I=1, ICON).

STACK	Stack (factory) name A10 (without apostroph)
SKOR(1), (SKOR(2)	UTMX (km), co-ordinates of the stack UTMY (km)
SKORTE	Text, corresponding to SKOR(3) -- SKOR(9), **within apostrophes**. The text contains the detailed stack information
IFU	Fuel type code, according to the emission factor file.
CON	Consumption data sets, with units corresponding to the emission factor file. In the calculations we decide which data set we want to use.

Emission factors are read from the file INFAK (with apostrophes and .DAT), see the separate description of the emission factor file.

Example:

From Pécs we have a file with point source data and 5 sets with consumption data: for every 3 months and for a year. The point source data will be copied to a new file together with calculated emission data.
In addition to these emissions there will be emissions from industrial processes that has to be included in the point source dispersion calculations.

21,14,4	Grid size, 4 components
'FELMER5.DAT'	Point source file with source data and consumption data
'EM-P-WIN'	Point source emission file, emissions from "point sources", winter
'WINTER','PECS'	Period, place
1	ICONS=1, consumption for January-February-March
90	90 days
'EMISSZIO.DAT'	Emission-factor file
0.5,0.5,0.5,0.5	Limits for the emissions of SO2, NOx, CO and PART

The beginning of the stack file FELMER5.DAT is:

```
L:\USER\FG\PECS\FELMER5.DAT
Start
Point sources in Pecs
1000,               Grid size
576.0,74.0,         UTMx,UTMy
0,                  North is north
4,0,                4 normal compounds
0.0,                Background
N,                  No correction for topography
Y,                  Alpha=1.0
3,                  McElroy-Pooler for low, Brookhaven for high sources
Y,                  50 m separates high and low sources
2,1,                Emissions in kg/h, temp in oC
STACK      UTMX    UTMY    SKORTE                            IFU  CON(1)   CON(2)   CON(3)   CON(4)   CON(5)
AAAAAAAAAAxxxxxxxXXXXXXX AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA  I   xxxxxx   xxxxxx   xxxxxx   xxxxxx   xxxxxx
Initato KF 587.240 75.090 ' 107  1  1 15  1.000 gazolaj  1'  29   1.000    1.000    1.000    1.000    4.000
PLASTEX My 584.910 75.840 ' 144  1  1 14  1.440 tyzelool 1'  21  39.546    2.600    0.000   13.375   55.521
PLASTEX My 584.910 75.840 ' 144  1  2 14  0.300 tyzelool 1'  21   5.100    5.100    7.843    3.625   21.668
Aroma BT s 580.536 77.800 ' 304  1  1  8  0.090 kemenyfa 1'  12  21.000    0.000    8.000   26.000   55.000
Aroma BT s 580.536 77.800 ' 304  1  2  8  0.090 kemenyfa 1'  12  21.000    0.000    8.000   26.000   55.000
INTERGLOB  585.420 79.050 ' 439  2  4  9 12.000 higito   1'   0   0.025    0.025    0.025    0.025    0.100
INTERGLOB  585.420 79.050 ' 439  2  4  9 12.000 festek   1'   0   0.028    0.028    0.028    0.027    0.111
K>zterylet 586.920 79.210 ' 442  5  4  7  0.160 festek,h 1'   0   0.067    0.060    0.083    0.053    0.263
K>zterylet 586.920 79.210 ' 442  5  5  7  0.160 festek,h 1'   0   0.067    0.060    0.083    0.053    0.263
Gomba Komp 590.620 79.550 ' 492  2  1 18  0.800 tyzelool 1'  21   2.250    1.500    1.500    2.250    7.500
EPGEP Pann 586.560 79.580 ' 484 12  1 12  1.400 festek   1'   0   3.100    3.100    3.100    3.100   12.400
EPGEP Pann 586.560 79.580 ' 484 12  3 14  0.137 tyzelool 1'  21   2.450    2.450    2.450    2.450    9.800
EPGEP Pann 586.560 79.580 ' 484 12  5 11  0.126 higito   1'   0   0.750    0.750    0.750    0.750    3.000
B.M Z>lder 585.220 79.760 ' 481  7  1 21  1.200 szen     1'  50  35.000   10.000    0.000   25.000   70.000
Gepjavito  590.940 79.800 ' 492  4  1 18  0.260 szen     1'  50  16.000    0.000    0.000   14.000   30.000
Gepjavito  590.940 79.800 ' 492  4  2  6  0.120 kovacssz 1'  51   0.050    0.050    0.050    0.050    0.200
Agraria Ke 586.720 79.800 ' 484 10  5 10  0.283 kovacssz 1'  51   0.030    0.030    0.030    0.030    0.120
Pecsi  mez 590.340 79.820 ' 491  1  5 18  0.560 szen     1'  50  20.500    0.000    0.000   18.500   39.000
Pecsi  mez 590.340 79.820 ' 491  1  5 18        fa       1'  11  13.000    0.000    0.000   11.000   24.000
```

and so on. The actual file has 235 point sources, many with small emissions. The fuel types are written in Hungarian, and the fuel code is missing for many of the sources. The text within the apostrophes is not used by the program, but more detailed stack data should be included here before you are using the file as input to POI-KILD.

The output of the program is found at three files: Stack data and point source emissions are written to the file OUTFI.DAT, the area emission fields (if any) will be written binary to the file OUTFI.FLD, the output is written to the file OUTFI.PRN. Messages from the emission calculations are also written to the file OUTFI.PRN, as shown below. The file OUTFI.DAT has to be arranged a little, in order to be useful as input to POI-KILD.

From the example the beginning of the output-file EM-P-WIN.PRN is:

```
  Emission factors are read from file EMISFACT.DAT
Emiss
IFU
IIIIx
   4 Fuel type            UNIT       DENS      SO2      NOx      CO       Part
   1 Gasoline cars <3.5t g/km       1.000     .050    2.120    9.100     .240
   2 Diesel 3.5-16t       g/km       1.000     .110    7.400    7.300     .820
   3 Heavy diesel truck   g/km       1.000    1.470   14.800    7.300    1.400
   4 Bus                  g/km       1.000    1.350   18.200    6.200    1.200
   5 Motor cycle          g/km       1.000     .080     .080   22.000     .170
  11 Sawdust              ton        1.000     .040    3.000   15.000   10.000
  12 Wood (kemenyfa)      ton        1.000     .050    3.000   15.000    2.100
  21 Dom. fuel,  .3%S     ton        1.000    5.500    2.500    1.300     .200
  23 Med. fuel, 1.2%S     ton        1.000   23.000    4.500    1.200    5.000
  24 Med. fuel, 3.0%S     ton        1.000   57.000    4.500    1.200    5.000
  28 Diesel oil           ton        1.000    3.800    2.500    1.300     .200
  29 Gas oil, .05%S       ton        1.000     .900    2.500    1.300     .200
  41 Earth gas(foldgaz)   m3          .001     .130    1.800    1.400     .100
  42 Biogas               m3          .001     .030     .060    1.800     .020
  50 Coal (szen)          t          1.000   48.500    3.000   31.800   46.300
  51 Pecs coal(aknaszen)  ton        1.000   34.000    2.400   31.900   65.400
  53 Coal dust(porszen)   ton         .001   26.600    3.000   31.900    1.800
  57 Coal nuts(dio szen)  ton        1.000   42.000    3.000   32.400   48.600
  59 Coke (koksz)         ton        1.000   38.000    6.000   32.700   20.600
  65 Komloi dara          ton        1.000   41.800    3.000   30.000   74.200
  91 Kender               ton        1.000     .001     .490   12.190   18.290

 Stack data are read from file FELMER5.DAT  and written to EM-P-WIN.DAT
```

The emission factor file must be adjusted for each place, due to differences in vehicle types, fuel types etc.

```
 Source Initato KF has emissions from use of     1.0 ton   of fuel type 29 in (12, 2):   .000    .001    .001    .000
 Source PLASTEX My has emissions from use of    39.5 ton   of fuel type 21 in ( 9, 2):   .101    .046    .024    .004
 Source PLASTEX My has emissions from use of     5.1 ton   of fuel type 21 in ( 9, 2):   .013    .006    .003    .000
 Source Aroma BT s has emissions from use of    21.0 ton   of fuel type 12 in ( 5, 4):   .000    .029    .146    .020
 Source Aroma BT s has emissions from use of    21.0 ton   of fuel type 12 in ( 5, 4):   .000    .029    .146    .020
 Fuel type missing:
INTERGLOB  585.420 79.050 ' 439  2  4  9 12.000 higito  ' 1  0    .025     .025     .025     .025     .100
 Fuel type missing:
INTERGLOB  585.420 79.050 ' 439  2  4  9 12.000 festek  ' 1  0    .028     .028     .028     .027     .111
 Fuel type missing:
K>zterylet 586.920 79.210 ' 442  5  4  7   .160 festek,h' 1  0    .067     .060     .083     .053     .263
 Fuel type missing:
K>zterylet 586.920 79.210 ' 442  5  5  7   .160 festek,h' 1  0    .067     .060     .083     .053     .263
 Source Gomba Komp has emissions from use of     2.3 ton   of fuel type 21 in (15, 6):   .006    .003    .001    .000
 Fuel type missing:
EPGEP Pann 586.560 79.580 ' 484 12  1 12  1.400 festek  ' 1  0   3.100    3.100    3.100    3.100   12.400
 Source EPGEP Pann has emissions from use of     2.5 ton   of fuel type 21 in (11, 6):   .006    .003    .001    .000
 Fuel type missing:
EPGEP Pann 586.560 79.580 ' 484 12  5 11   .126 higito  ' 1  0    .750     .750     .750     .750    3.000
 Source Gepjavito  has emissions from use of    16.0 t     of fuel type 50 in (15, 6):   .359    .022    .236    .343
 Source Gepjavito  has emissions from use of      .1 ton   of fuel type 51 in (15, 6):   .001    .000    .001    .002
 Source Agraria Ke has emissions from use of      .0 ton   of fuel type 51 in (11, 6):   .000    .000    .000    .001
 Source Pecsi  mez has emissions from use of    20.5 t     of fuel type 50 in (15, 6):   .460    .028    .302    .439
 Source Pecsi  mez has emissions from use of    13.0 ton   of fuel type 11 in (15, 6):   .000    .018    .090    .060
 Source Bader Bt   has emissions from use of      .3 ton   of fuel type 21 in ( 6, 7):   .001    .000    .000    .000
 Source MOL Rt Ig. has emissions from use of    21.6 ton   of fuel type 21 in ( 6, 7):   .055    .025    .013    .002
 Source Bader Bt   has emissions from use of      .6 ton   of fuel type 21 in ( 6, 7):   .002    .001    .000    .000
 Source Bader Bt   has emissions from use of     1.2 ton   of fuel type 21 in ( 6, 7):   .003    .001    .001    .000
```

and so on. The point sources are written to EM-P-WIN.DAT.

```
Norwegian institute for air research (NILU)
       "KILDER" program package license for
    South Trans-Danubian Environmental Inspectorate,
                   Pecs, Hungary
                 VERSION 2.0, 15-2-1997
                 - - - - O O O - - - -


 MAP OF : SO2              UNIT:  kg/h              SOURCE: FELMER5.DAT
 PERIOD : WINTER 95

   PLACE: PECS             GRID SIZE: 1000 METER
 CREATED: 1997/10/23 16.55


     MAXIMUM VALUE IS  8.2632E-01, IN (15, 6)
                 SUM= 4.04065E+00    SCALE FACTOR:  1.0E-04
```

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
J=14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	209.	.	.	.	980.	.	.
J=13	.	.	.	.	.	.	.	.	.	.	.	.	.	1749.	.	.	.	.	.	145.	.
J=12	.	.	.	.	.	.	.	.	.	.	.	.	1332.	.	.	.	.	.	.	.	.
J=11	.	.	.	.	.	.	.	.	.	.	.	.	.	395.	.	.	.	.	.	.	.
J=10	.	.	.	.	.	.	.	.	.	.	27.	.	.	175.	172.	.	.	.	.	.	.
J= 9	.	.	.	.	.	.	.	.	.	323.	1100.	.	842.	351.	349.	.	.	.	.	.	.
J= 8	.	.	.	.	.	.	.	.	1068.	.	511.	371.	216.	3840.	.	.	.	.	.	.	.
J= 7	.	.	.	805.	866.	649.	2925.	634.	26.	2898.	345.	285.	52.	6768.	.	.	.	.	.	.	.
J= 6	.	.	.	.	.	.	.	.	.	321.	211.	.	.	.	8263.	.	.	.	.	.	.
J= 5	.	.	.	.	.	.	.	.	.	45.	.	.	.	.	.	.	.	.	.	.	.
J= 4	.	.	.	.	10.	.	.	.	.	5.	.	.	.	.	.	.	.	.	.	.	.
J= 3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
J= 2	.	.	.	.	.	.	.	.	1137.	.	.	4.	.	.	.	.	.	.	.	.	.
J= 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

Similar maps are given for the other compounds:

```
MAP OF : NOx              UNIT:  kg/h             SOURCE: FELMER5.DAT
PERIOD : WINTER 95       PLACE:  PECS           GRID SIZE: 1000 METER
CREATED: 1997/10/23 16.55

    MAXIMUM VALUE IS  7.0738E-01, IN (11, 8)
                SUM= 4.56445E+00    SCALE FACTOR:  1.0E-04


MAP OF : CO               UNIT:  kg/h             SOURCE: FELMER5.DAT
PERIOD : WINTER 95       PLACE:  PECS           GRID SIZE: 1000 METER
CREATED: 1997/10/23 16.55

    MAXIMUM VALUE IS  6.2973E-01, IN (15, 6)
                SUM= 5.45041E+00    SCALE FACTOR:  1.0E-04


MAP OF : Particle         UNIT:  kg/h             SOURCE: FELMER5.DAT
PERIOD : WINTER 95       PLACE:  PECS           GRID SIZE: 1000 METER
CREATED: 1997/10/23 16.55

    MAXIMUM VALUE IS  8.4429E-01, IN (15, 6)
                SUM= 2.52600E+00    SCALE FACTOR:  1.0E-04
```

The point source file EM-P-WIN.DAT will look like:

```
L:\USER\FG\PECS\FELMER5.DAT
Name          x       y     grid                   fuel        if     1            2            3
AAAAAAAAAxxxxxxxxxxxxx
Start
Point sources in Pecs
1000
  576.00   74.00
     .00
          4           0
     .00
N,
Y,
          3
Y
  2   1
Name          x       y     grid                   fuel        if     1      SO2     NOx     CO      Particle
AAAAAAAAAxxxxxxxxXXXXXXX AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA I  I  xxxxxx   xxxxxx   xxxxxx   xxxxxx
```

```
B.M Z>lder 585.22  79.76 ' 481  7  1 21  1.200 szen           ' 1    .79    .05     .52     .75
BAZIS DEV  582.26  80.13 ' 517  1 12 21  1.130 tyzelool       ' 1    .92    .42     .22     .03
Pecsi Hoer 589.34  80.28 ' 531  1              pakura         ' 1   4.17    .33     .09     .37
DRAVA PIER 579.33  80.34 ' 511  1  1 11  0.104 szen           ' 1    .76    .05     .50     .73
DRAVA PIER 579.33  80.34 ' 511  1  2 11  0.104 szen           ' 1    .76    .05     .50     .73
MAV vontat 586.08  80.96 ' 567 42  1 30  0.690 szen           ' 1   2.33    .14    1.53    2.22
MAV vontat 586.08  80.96 ' 567 42  2 30  0.690 szen           ' 1   2.33    .14    1.53    2.22
P & Tsai F 587.02  81.20 ' 611 23  1 23  0.283 koksz,fa       ' 1    .86    .14     .74     .47
M Design V 584.56  81.38 ' 606 11  2  3  0.110 levalasz       ' 1    .62    .04     .41     .59
Tydoszanat 585.94  83.16 ' 776  7  1     0.177 futoolaj       ' 1    .86    .07     .02     .08
Tydoszanat 585.94  83.16 ' 776  7  2     0.177 futoolaj       ' 1   3.10    .24     .07     .27
Hirdi Fono 595.49  86.34 '1047  2  1 22  0.360 kender h       ' 1    .10  49.98 1243.38 1865.58
Hirdi Fono 595.49  86.34 '1047  2  1  8  0.181 pakura         ' 1   1.06    .08     .02     .09
Hirdi Fono 595.49  86.34 '1047  2  1  7  0.096 kender h       ' 1    .00   1.47   36.57   54.87
Hirdi Fono 595.49  86.34 '1047  2  1  7  0.096 kender h       ' 1    .00   1.47   36.57   54.87
```

and so on.

The point source file EM-P-WIN.DAT has to be arranged a little before it can be used as input to POI-KILD: In the area between the apostrophes shall the following data be included:

SKOR(3)	Stack base (m.a.s.l.)
SKOR(4)	Stack height (m)
SKOR(5)	Stack diameter (m)
SKOR(6)	Gas temperature, °C or K, according to index ITT
SKOR(7)	Gas velovity (m/s)
SKOR(8)	Building height (default 10 m)
SKOR(9)	Building width (default 30 m)

In the example the source group code is 1 for all sources, but this can be adjusted now.

Atmospheric stability

In its simplest terms, the term **stability** of the atmosphere is its tendency to resist or enhance vertical motion, or alternatively to suppress existing turbulence. Stability is related to both wind shear and temperature structure in the vertical, but it is generally the latter which is used as an indicator of the condition.

The actual distribution of temperature in the vertical is known as "atmospheric lapse rate". This seldom approximates the adiabatic lapse rate in the lowest 100 m over any extended time period. Examples of typical atmospheric lapse rates are shown in Figure 1. The different atmospheric conditions (temperature profiles) also act different on vertical plume dispersion.

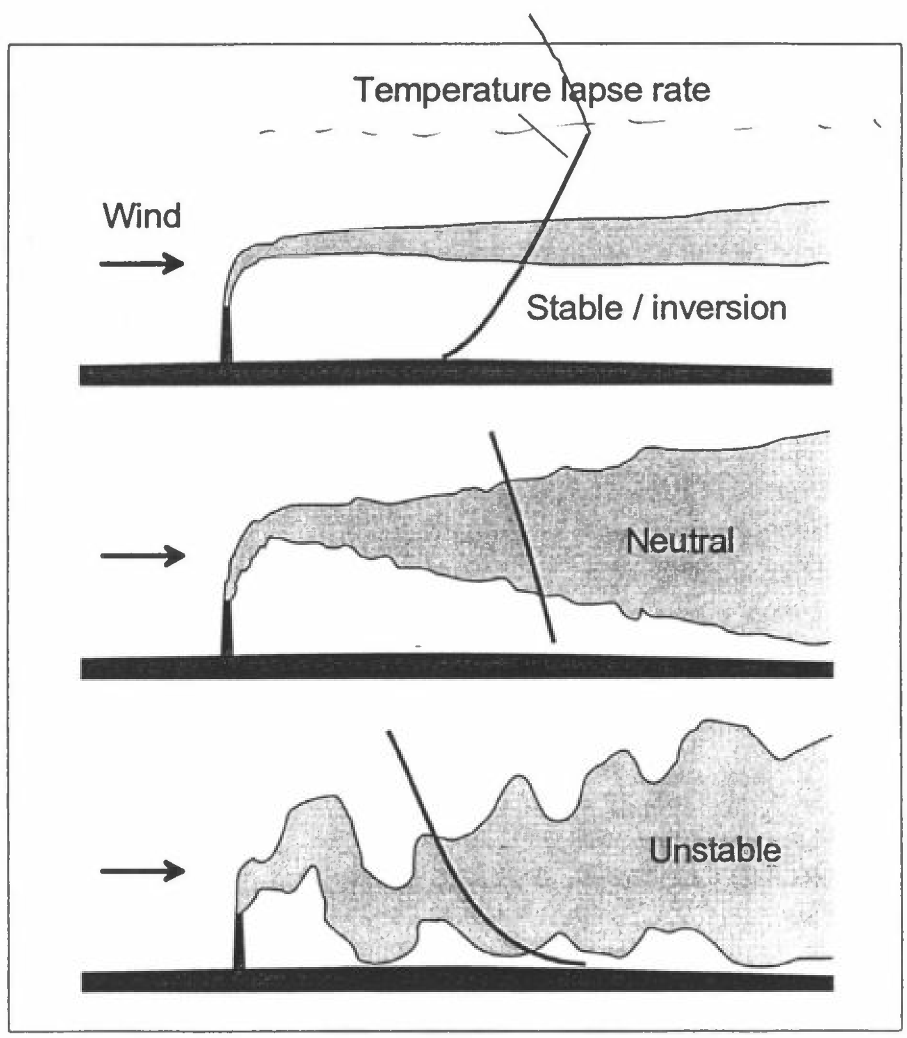

Figure 1: Typical atmospheric lapse rates and corresponding plumes.

On days with strong solar heating or when cold air is being transported over a much warmer surface (sea), the rate of decrease of temperature with height usually exceeds -1 °C/100 m, implying that any small volume displaced upwards would become less dense than its surroundings and tend to continue its upward motion. A superadiabatic condition favours strong convection, **instability**, and turbulence. Superadiabatic conditions are usually confined to the lowest 200 m of the atmosphere.

A neutral condition in which the lapse rate in the atmosphere is nearly identical to the dry adiabatic lapse rate, implies no tendency for a displaced parcel to gain or loose buoyancy. **Neutral** conditions are associated with overcast skies and moderate to strong wind speeds.

An atmosphere in which the temperature decreases more gradually than -1 °C/100 m is actually **slight stable**, since a small parcel displaced upwards will become more dense than its surroundings and tend to descend to its original position, whereas a parcel downwards will become warmer and rise to the original level.

When the ambient temperature is constant with height, the layer is termed isothermal and as in the superadiabatic case there is a slight tendency for a parcel to resist vertical motion.

A **stable** atmospheric layer in which temperature increases with height strongly resists vertical motion and tends to suppress turbulence. It is therefore of particular interest in air pollution, since it allows very limited dispersion. There has also been much confusion over different types of temperature inversions, and clarification is therefore particularly in order (Figure 2).

Stability parameters

Several parameters for describing the stability conditions or turbulence in the atmosphere have been evaluated:

- the vertical temperature difference ($\delta T/\delta z$),
- the Bulk Richardson number (Ri_B),
- horizontal fluctuations in wind direction (σ_θ),
- Pasquill-Gifford classification.

Pasquill and Gifford studied cloud growth and standard deviations of wind direction for a plume from a 100 m. stack (Brookhaven) and defined six turbulence classes discriminated by wind speed, cloud cover and solar radiation as shown in Table 1.

In the KILDER system four stability classes are used: Unstable, Neutral, Light stable and Stable. The unstable classes A-C from Pasquill-Gifford are combined to one unstable class.

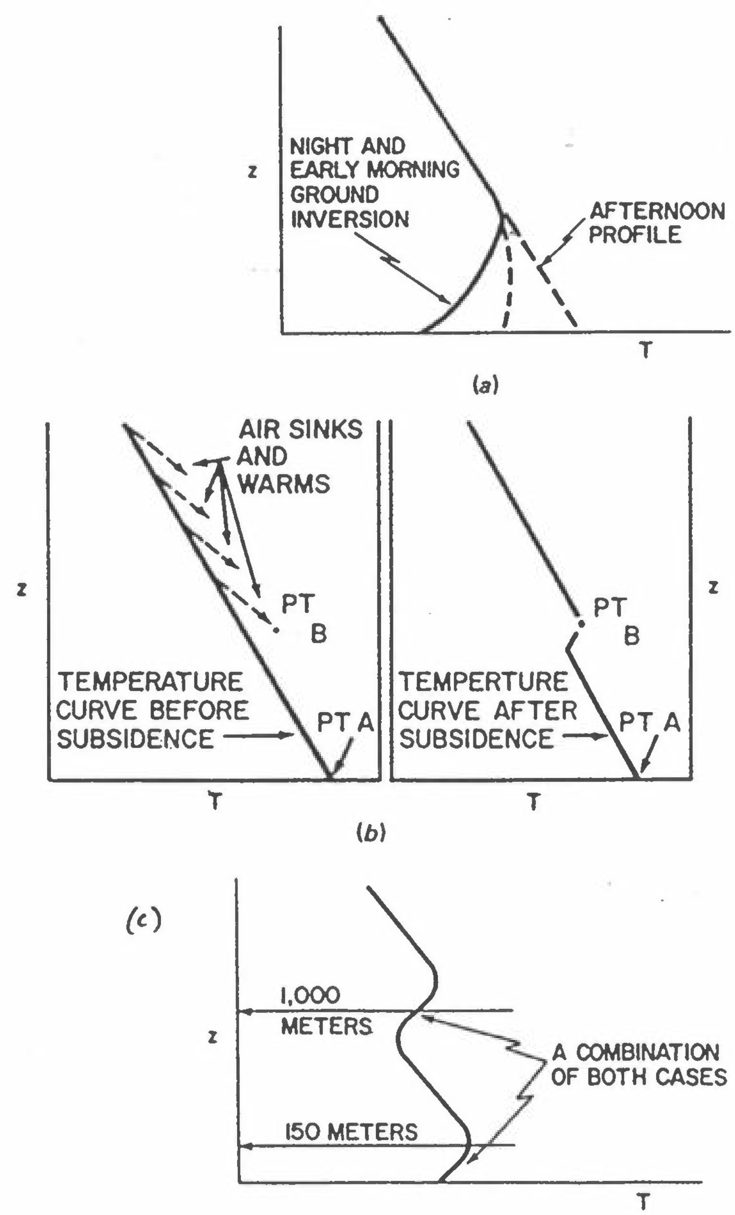

Figure 2: Temperature inversions. (a) During the day. (b) The sinking of air leads to warming aloft the formation of inversions. (c) A combination of cases.

Table 1: Relation of turbulence types to weather conditions

A: Extremely unstable conditions	**D: Neutral conditions**
B: Moderately unstable conditions	**E: Slightly stable conditions**
C: Slightly unstable conditions	**F: Moderately stable conditions**

Surface wind speed, m/sec	Daytime insolation			Nighttime conditions	
	Strong	Moderate	Slight	Thin overcast or $\geq$ 4/8 cloudiness	$\leq$3/8 cloudiness
<2	A	A	B	F	
2-3	A-B	B	C	E	F
3-4	B	B-C	C	D	E
4-6	C	C-D	D	D	D
>6	C	D	D	D	D

The Bulk Richardson number (Ri_B) includes both thermal induced turbulence (temperature stratification) and mechanical induced turbulence (wind profile) to describe the dispersion conditions in the area.

$$Ri_B = g\,(\Delta\theta/\Delta z)\,z^2/(T\,u^2),$$

where $\Delta\theta$ is the potential difference measured between the height difference Δz. z is the height above the surface of the measured wind speed (u) and g/T is the buoyancy parameter. The criteria for the four classes of turbulence were:

I	:	Unstable		$< Ri_B$	< -0.003
II	:	Neutral	-0.003	$< Ri_B$	< 0.0075
III	:	Light stable	0.0075	$< Ri_B$	< 0.05
IV	:	Stable	0.05	$< Ri_B$	

Figure 3 shows typical seasonal and diurnal variations of stability in Bilbao, Spain, based upon temperature difference and the Bulk Richardson number. Unstable conditions and well developed vertical dispersion of air pollutants most often occurred in the early afternoon in the spring and summer seasons. The Bulk Richardson parameter resulted in a higher frequency of near neutral conditions at daytime, especially in the early afternoon. This was caused by the relatively high wind speeds occurring in the sea breeze at these hours.

At night time hours, stable conditions occurred during all seasons. In the winter season light stable and stable conditions occurred both night and day.

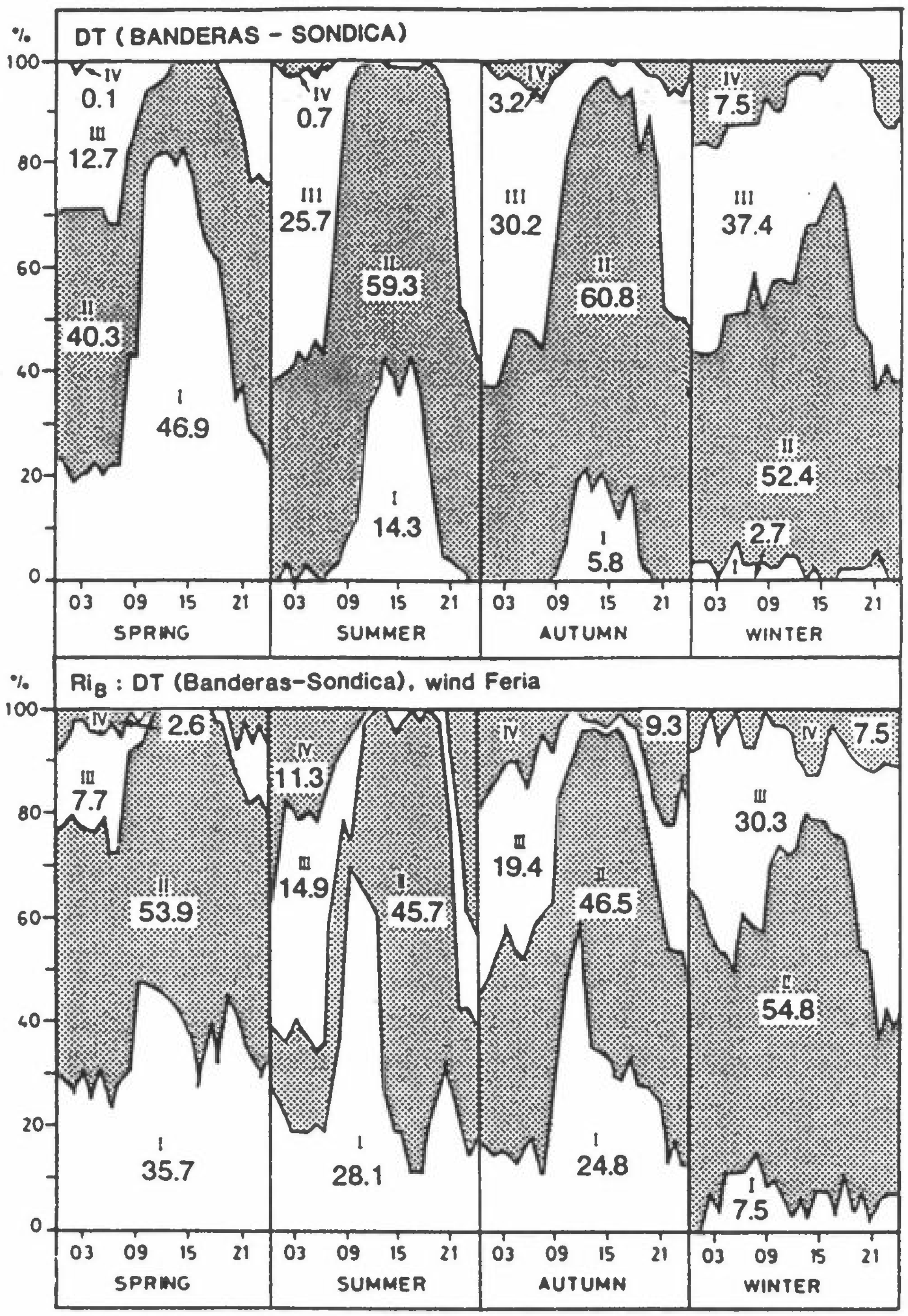

Figure 3: Seasonal and diurnal variation of four classes of stability based upon temperature difference and the Bulk Richardson number.

Population distribution

To prepare an emission survey many of the activities has to be distributed according to the population distribution. We have several programs that uses population distribution to estimate consumption of fuels and other activities in different ways. The population distribution is also used in exposure estimations.

The best and most correct way to prepare a population survey for a city is to use the data from the latest census, which should give the number of inhabitants within each building. A GIS-registration (Geographical Information System) for the city will give us the coordinates for all the buildings, and a km^2-distribution is easy to prepare. Such a procedure is unfortunately only future in most cities. We are therefore limited to use the existing data and make the best out of it.

For calculation of a population distribution field we have three different programs: **DIST-POP, POP-DIST** and **POP-FIE**. These are prepared in order to solve the problems for different cities, and are based upon different types of data.

The program **DIST-POP** gives a coarse population distribution, based upon very little informations:

- studies of a detailed map of the area and
- the population within districts or regions.

From the map distribution keys to the squares are estimated, based upon a judgement of relative population density within a region. For some areas we know that there is a dense population, in other areas there are parks, sea, industry or other regions with low population. For all squares belonging to the region a relative population density is estimated, and the population is distributed according to this.

A national census it will normally give data for the population within sub-districts. They always exists, but it can be difficult to get hold of the reports. The census data are read in the program **POP-DIST**, which calculates how many % of of the population in the district that lives within each sub-district.

For distributing the population to the grid this is done by the program **POP-FIE**. The work starts with a map with the grid, and with the borders of each district and sub-district. From POP-DIST we know how many % of the total population in the district that lives within each sub-district, and this is distributed to the squares covered by the sub-district. When it is homogeneous the area distribution may be used, otherwise dense populated parts must be given more weight than the rest of the sub-district, and parks etc. low weight. For each district we are making the sum of the individual contributions from the sub-districts to the squares it covers (manually). In this way we are preparing a population distribution key file DISTFILE.DAT to transfer the population figures to the grid, as shown in the example in the program description.

In **POP-FIE** we are calculating the population fields. When the distribution key is established, it is later easy to distribute new population figures. We may have several different sets for the population data on POPFILE.DAT (ex. POP1990, POP2000 and POP2010), and we select which we want. We may also have different distribution files according to different area use plans, but such plans will normally only affect the distribution in special districts.

This program is written as a tool for distributing characteristics when total figures for several districts are given. This will mainly be population, but it has also been used to distribute working places and wood consumption.

DIST-POP

The program DIST-POP gives a coarse population distribution, based upon very little informations except studies of a map of the area and the population within districts or regions. The program DIST-POP is based upon a judgement of relative population density within a region. For some areas we know that there is a dense population, in other areas there are parks, sea, industry or other regions with low population. For all squares belonging to the region a relative population density is estimated, and the population is distributed according to this.

Input data to DIST-POP

INFILE	Population file (with apostrophes and .DAT)
OUTFILE	Result-file (with apostrophes)
ISIZE	Grid size in meters
PERIOD, PLACE, SOURCE (with apostrophes)	
NT, JT	There are NT data sets on file INFILE, we want to use no. JT.

Population data are read from INFILE:

The file is read until Start or START in col. 1-5. Then the following data is read for each region:

IZO, NAME — Zone number (I4) and name of the region (without apostrophes)

IPERC, (POPU(I), I=1, NT)

IPERC % of the population in the region is covered by the grid.

POPU population data sets, we want to use no. JT

For each square covered by the region is read:

I, J, IP (I, J)	I, J	index of the square
	IP (I, J)	population index

Values are read until I=0 or I= -1. The indices for the region are added, and the population P (I, J) in square (I, J) is calculated as:

$$P(I, J) = (POPU(JT) * IPERC/100.) * IP(I, J) / \Sigma IP,$$ where

Σ IP is the sum of the population indices for the region.

The population is written to OUTFILE.FLD and with print-out at OUTFILE.PRN.

Example:

In NILUs URBAIR-study the population of Manila, in the Philippines was given for 17 regions for the years 1990 and 2000.

```
MANI-FOR.DAT
IPE    1990    2000
iiiffffff.FFFFFFF.
Start
 1Manila
100 1601234 1586900
 1 24  3
 1 23  6
 1 22  6
 1 21  4
 2 24 10
 2 23  8
 2 22 10
 2 21  9
 2 20  4
 2 19  5
 3 24  7
 3 23  8
 3 22  8
 3 21  8
 3 20  4
 3 19  1
 3 18  2
 4 16  3
 4 17  7
 4 18  8
 4 19  7
 4 20  5
 4 21  7
 4 22  8
 4 23  9
 4 24  2
 4 25  1
 5 23  3
 5 22  1
 5 21  9
 5 20  2
 5 19  4
 5 18  7
 5 17  9
 6 17  3
 6 18  8
 6 19  3
 6 20  2
 6 21  9
 6 22  5
 7 21  4
 7 20  5
 7 19  2
 8 20  3
-1
 2Caloocan City
 50  763415  975261
 2 27  4
 2 26  3
 2 25  8
 3 25  9
 3 26  9
 3 27  9
 4 27  9
 4 26  9
```

```
 4 25  4
 5 26  3
 5 27  7
 5 28  5
 6 28  3
 6 29  3
-1
 3Pasay City
100  368366  416772
 3 16  3
 3 15  3
 4 16  7
 4 15  7
 4 14  2
 5 16  5
 5 15  9
 5 14 10
 5 13  4
 5 12  4
 5 11  2
 6 15  4
 6 14  7
 6 13  8
 6 11  3
 7 13  1
 7 12  4
 8 12  3
-1
 4Quezon City
 90 1669776 1998546
 4 23  1
 4 24  2
 5 23  7
 5 24  9
 5 25  8
 5 26  4
 5 27  1
 6 22  5
 6 23  6
 6 24  6
 6 25  7
 6 26  4
 6 27  2
 6 28  2
 7 29  3
 7 28  4
 7 27  3
 7 26  5
 7 25  8
 7 24  6
 7 23  3
 7 22  4
 7 21  2
 8 22  4
 8 23  5
 8 24  8
 8 25  8
 8 26  8
 8 27  7
 8 28  7
 8 29  6
```

```
  9 29  6
  9 28  6
  9 27  5
  9 26  5
  9 25  4
  9 24  7
  9 23  6
  9 22  6
  9 21  1
 10 22  4
 10 23  7
 10 24  7
 10 25  3
 10 26  1
 10 27  5
 10 28  6
 10 29  6
 11 29  5
 11 28  5
 11 26  3
 11 25  6
 11 24  6
 11 23  7
 11 22  6
 11 21  3
 12 20  7
 12 21  5
 12 22  6
 12 23  6
 12 24  8
 12 25  6
 12 26  4
 12 27  1
 12 28  4
 12 29  3
 13 29  3
 13 28  2
 13 27  4
 13 26  3
 13 25  3
 13 24  4
 13 23  5
 13 22  5
 13 21  5
 13 20  4
 14 20  4
 14 21  1
 14 25  2
 14 26  3
 14 27  2
 14 28  1
 14 29  2
 15 29  2
 15 28  1
 16 28  1
 16 29  1
 17 29  1
 -1
  5Malabon
  60   280037   339073
  0 27  4
  0 28  6
  0 29  3
  1 29  2
  1 28  2
  1 27  3
  1 26  5
  2 29  4
  2 28  9
  2 27  1
  3 29  1
  3 28  6
  4 28  5
  5 28  4
  5 29  1
 -1
  6Navotas
  80   187479   228536
  0 27  3
  0 26  4
  1 25  3
  2 25  2
  1 26  5
 -1
  7Makati
 100   453170   499846
  5 16  4
  5 17  1
  6 17  7
  6 16  9
  6 15  6
  6 14  2
  7 18  3
  7 17  9
  7 16  9
  7 15  9
  7 14  9
  7 13  5
  8 18  2
  8 17  8
  8 16  7
  8 15  8
  8 14  9
  8 13  3
  9 17  4
  9 16  9
  9 15  8
  9 14  7
 10 17  5
 10 16 10
 10 15  1
 10 14  2
 11 17  1
 11 16  3
 11 15  2
 12 16  2
 12 15  2
 12 14  2
 -1
  8Valenzuela
  10   340227   430516
  3 29  4
  4 29  7
  5 29  2
 -1
  9Las Pinas
  90   297102   438362
  3  4  3
  3  5  5
  3  6  7
  3  7  2
  4  3  3
  4  4 10
  4  5  9
  4  6 10
  4  7  7
  4  8  1
  4  9  1
```

```
 5  1  1
 5  2  6
 5  3 10
 5  4 10
 5  5  7
 5  6  6
 5  7  6
 5  8  2
 6  1  3
 6  2  8
 6  3  9
 6  4  7
 6  5  8
 6  6  1
 6  7  4
 7  1  9
 7  2  8
 7  3  4
 7  4  7
 7  5  6
 8  1  2
 8  2  6
 8  3  7
 8  4  2
-1
10San Juan
100  126854  125280
 8 22  3
 8 21  9
 8 20  3
 9 22  1
 9 21  9
 9 20  9
10 21 10
10 20  5
11 21  7
-1
11Paranaque
100  308236  374656
 4  9  1
 5  9  1
 5 10  1
 5 11  1
 5 12  1
 6  6  1
 6  7  3
 6  8  3
 6  9  2
 6 10  1
 6 11  1
 6 12  1
 6 13  2
 6 14  4
 7  5  2
 7  6 10
 7  7  8
 7  8  3
 7  9  2
 7 10  9
 7 11  1
 8  3  1
 8  4  7
 8  5  9
 8  6  9
 8  7  9
 8  8  8
 8  9  8
 8 10  9
 8 11  3
 9  4  6
 9  5 10
 9  6  5
 9  7  5
 9  8  7
 9  9  6
 9 10  6
 9 11  5
10  4  3
10  5  7
10  6  7
10  7  8
10  8  9
10  9  9
10 10  6
10 11  2
11  6  1
11  7  1
11  8  2
11  9  1
11 10  3
11 11  2
-1
12Mandaluyong
100  248143  273192
 7 18  1
 8 18  3
 8 19  5
 8 20  1
 9 19  8
 9 18  8
 9 17  4
10 20  1
10 19  8
10 18  9
10 17  3
11 20  3
11 19  4
11 18  5
11 17  2
12 19  1
-1
13Pasig
100  397679  483837
11 17  3
11 18  1
12 16  3
12 17  9
12 18  7
12 19  6
13 15  1
13 16  6
13 17  5
13 18  7
13 19  8
14 15  1
14 16  5
14 17  3
14 18  4
14 19  1
14 22  3
15 15  1
15 16  2
15 17  3
15 18  1
15 19  2
15 20  2
15 21  1
15 22  2
```

```
16 18  3
16 19  4
16 20  1
16 21  7
16 22  7
17 18  3
17 19  1
-1
14Taguig
100  266637  375898
 8 13  2
 8 12  1
 9 13  1
 9 12  1
 9 10  3
10 13  2
10 10  7
10  9  2
10  8  1
10  7  1
11 11  4
11 10  8
11  9 10
11  8  2
11  7  3
11  6  2
12 13  2
12 11  1
12  9  2
12  8  2
12  7  1
13 13  2
13 12  2
13 11  2
14 14  2
14 11  2
14 10  7
15 14  1
-1
15Muntinlupa
 40  278411  397284
 8  1  6
 8  2  1
 9  1  6
 9  2  6
 9  3  7
 9  4  4
10  2  3
10  3  8
11  1  2
11  2  2
11  3  2
11  4  2
-1
16Pateros
100   51409   58079
12 14  8
12 15  5
13 14  7
13 15  9
14 15  1
-1
17Marikina
 70  310227  375627
14 23  5
14 24  3
14 25  1
15 23  7
15 24  8
15 25  2
15 26  1
16 23  9
16 24  8
16 25  8
16 26  3
16 27  1
17 24  2
17 25  4
17 26  8
17 27 10
17 28  7
17 29  1
-1
```

The print-out at file MANI-FOR.PRN will be:

```
Population in region  1 Manila        is 1601234.persons
Population in region  2 Caloocan City is  381708.persons
Population in region  3 Pasay City    is  368366.persons
Population in region  4 Quezon City   is 1502798.persons
Population in region  5 Malabon       is  168022.persons
Population in region  6 Navotas       is  149983.persons
Population in region  7 Makati        is  453170.persons
Population in region  8 Valenzuela    is   34023.persons
Population in region  9 Las Pinas     is  267392.persons
Population in region 10 San Juan      is  126854.persons
Population in region 11 Paranaque     is  308236.persons
Population in region 12 Mandaluyong   is  248143.persons
Population in region 13 Pasig         is  397679.persons
Population in region 14 Taguig        is  266637.persons
Population in region 15 Muntinlupa    is  111364.persons
Population in region 16 Pateros       is   51409.persons
Population in region 17 Marikina      is  217159.persons
```

```
     Norwegian institute for air research (NILU)
        "KILDER" program package license for
             Norsk institutt for luftforskning,
                 Kjeller, Norge
               VERSION 2.0, 15-2-1997
               - - - - O O O - - - -

MAP OF : POPULATION         UNIT: PERSONS            SOURCE: POPULATION
PERIOD : 1990              PLACE: MANILA          GRID SIZE: 1000 METER
CREATED: 1997/03/28 17.07

     MAXIMUM VALUE IS  6.6997E+04, IN ( 3,22)
               SUM= 6.65418E+06    SCALE FACTOR:       10.
```

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
J=29	900.	600.	1200.	1347.	1832.	823.	1347.	1156.	2312.	2312.	2312.	1927.	1156.	1156.	771.	771.	385.	632.
J=28	1800.	600.	2700.	1800.	1500.	3445.	2118.	1541.	2697.	2312.	2312.	1927.	1541.	771.	385.	385.	385.	1727.
J=27	3847.	900.	2096.	4042.	4042.	3529.	771.	1156.	2697.	1927.	1927.	.	385.	1541.	771.	.	247.	2468.
J=26	3529.	5911.	1347.	4042.	4042.	2889.	1541.	1927.	3083.	1927.	385.	1156.	1541.	1156.	1156.	247.	740.	1974.
J=25	.	2647.	5357.	4042.	2466.	3083.	2697.	3083.	3083.	1541.	1156.	2312.	2312.	1156.	1017.	494.	1974.	987.
J=24	.	2010.	6700.	4690.	2111.	3468.	2312.	2312.	3083.	2697.	2697.	2312.	3083.	1541.	740.	1974.	1974.	494.
J=23	.	4020.	5360.	5360.	6415.	4707.	2312.	1156.	1927.	2312.	2697.	2697.	2312.	1927.	1234.	1727.	2221.	.
J=22	.	4020.	6700.	5360.	5360.	670.	5277.	1541.	2221.	2539.	1541.	2312.	2312.	1927.	1056.	704.	2463.	.
J=21	.	2680.	6030.	5360.	4690.	6030.	6030.	3451.	2039.	2424.	2265.	2742.	1927.	1927.	385.	352.	2463.	.
J=20	.	.	2680.	2680.	3350.	1340.	1340.	3350.	3065.	2039.	1509.	1128.	2697.	1541.	1541.	704.	352.	.
J=19	.	.	3350.	670.	4690.	2680.	2010.	1340.	1880.	3008.	3008.	1504.	2488.	2815.	352.	704.	1408.	352.
J=18	.	.	.	1340.	5360.	4690.	5360.	1185.	1667.	3008.	3384.	2232.	2463.	2463.	1408.	352.	1056.	1056.
J=17	.	.	.	.	4690.	6299.	3898.	2428.	2158.	2583.	2477.	2077.	3167.	1760.	1056.	1056.	.	.
J=16	.	.	.	1285.	5008.	3221.	2428.	2428.	1888.	2428.	2697.	809.	1595.	2112.	1760.	704.	.	.
J=15	.	.	.	1285.	2998.	3855.	3332.	2428.	2158.	2158.	270.	539.	1396.	1894.	523.	352.	.	.
J=14	.	.	.	.	857.	4283.	4069.	2428.	2428.	1888.	539.	.	1910.	1200.	702.	351.	.	.
J=13	.	.	.	.	.	1713.	3692.	1777.	1511.	351.	702.	.	702.	702.	.	.	.	.
J=12	.	.	.	.	.	1846.	133.	1713.	1636.	351.	.	.	.	702.	.	.	.	.
J=11	.	.	.	.	.	990.	1418.	133.	399.	664.	266.	1669.	351.	702.	702.	.	.	.
J=10	.	.	.	.	.	133.	133.	1196.	1196.	1850.	3253.	3205.	.	.	2456.	.	.	.

```
J= 9        .    .    .    . 269. 133. 266. 266.1063. 797.1897.3641. 702.    .    .    .    .    .
J= 8        .    .    .    . 136. 271. 399. 399.1063. 930.1547. 967. 702.    .    .    .    .    .
J= 7        .    .    . 271. 950. 814. 942.1063.1196. 664.1414.1185. 351.    .    .    .    .    .
J= 6        .    .    . 950.1357. 814. 269.1329.1196. 664. 930. 835.    .    .    .    .    .    .
J= 5        .    .    . 679.1222. 950.1086.1080.1196.1329. 930.    .    .    .    .    .    .    .
J= 4        .    .    . 407.1357.1357. 950. 950.1201.1706. 399. 455.    .    .    .    .    .    .
J= 3        .    .    .    . 407.1357.1222. 543.1083.1591.1818. 455.    .    .    .    .    .    .
J= 2        .    .    .    .    . 814.1086.1086.1042.1364. 682. 455.    .    .    .    .    .    .
J= 1        .    .    .    .    . 136. 407.1222.1635.1364.    . 455.    .    .    .    .    .    .
            1    2    3    4    5    6    7    8    9   10   11   12   13   14   15   16   17   18
```

```
 Data for 6654178. PERSONS    of POPULATION   for 1990   in MANILA
is written to file MANI-FOR.FLD date:1997/03/28 17.07
```

Program TRA-WORK

The calculation of area emissions from traffic, has to be done in two steps, by TRA-WORK and TRA-EMIS. Fields with **traffic work** is calculated in TRA-WORK, and these are multiplied by emission factors in TRA-EMIS.

First of all it is necessary to define a **main road network**, and perform traffic countings. The more informations that can be collected, the better the results will be. If detailed data exists (driving conditions, traffic composition etc.), more detailed models for calculating the emissions may be used. It is possible to some extent to use the results of traffic modelling, but these does not always include all traffic groups, and one should be careful to use the results uncritically, and be aware of all assumptions.

The work starts with a good official map for the area (1:20 000 or better), with a km-grid (UTM-system or similar). A tourist road map is not sufficient, as these are very often handdrawn and not to scale. All main roads should be registered, all main road crossings (= nodes) numbered, and the coordinates of the nodes should be measured out. If there is a bend of the road, it may be necessary to have an extra node. If the coordinates exists in a GIS-system, this would be excellent. In this way a road network is built up, and a file with node positions is made. It will also be useful to have the road names in the file, but the program does not need it. It is possible to transform the coordinates to another system, but the best will be to have the node positions in the correct system. This file should be plotted out by the program ROAD-PLO or other, to assure that the network is according to the maps. (This program is a part of the KILDER Model System, but it is dependent of the plotter facilities, and needs separate plotter driver routines. Therefore it is not included in the standard package.) Figure 1 below shows a plot of the main road network in the southern part of Bombay.

The next step is to fill the network file with traffic data. Normally this will be **A**nnual **A**verage **D**aily **T**raffic (AADT), but it might also be workday traffic WDT. Very often countings are performed with a morning period (06-09), a mid-day period (11-13) and an afternoon period (15-18). To extend this to AADT it is necessary to establish relationships between short-term countings and AADT. The countings may give total traffic, but should preferably be splitted into different vehicle groups. These may be private (mostly gasoline) cars, light utility vehicles (diesel), heavy trucks, buses and motorcycles/tricycles, depending on the local traffic composition. It will also be useful to carry out some hourly countings for a 24-hour period to get an impression of the diurnal variation, both of the total traffic and for the different vehicle groups.

In the beginning we may have data only from a few counting points, but with local knowledge about traffic streams the data may be extended to attached roads. Figure 2 below shows the beginning of a traffic data file from the URBAIR study in Bombay.

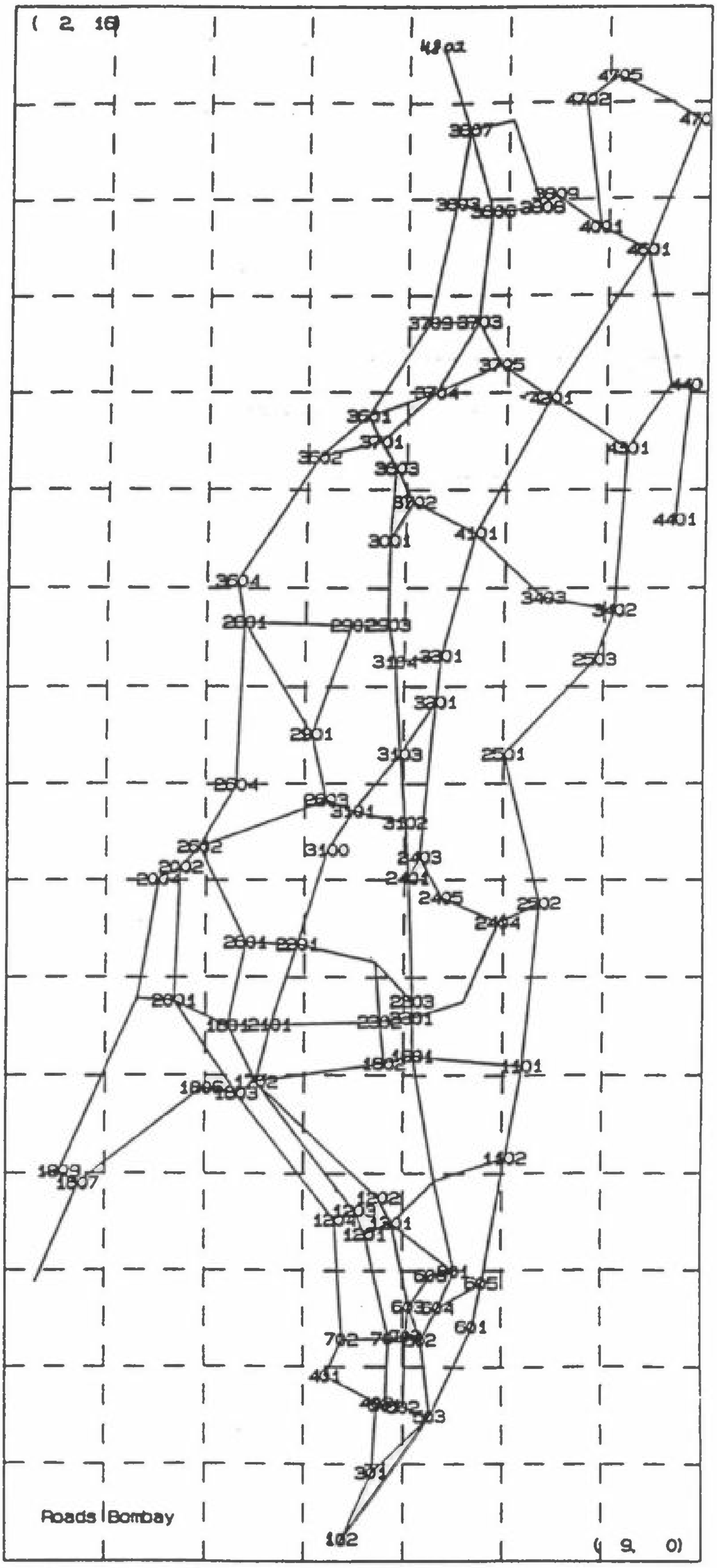

Figure 1: Main road network for Southern Bombay.

```
Traffic data for Bombay
aaaaaaaaaaAAAAAAAAAAaaaaaaaaaa   x1     y1     x2     y2   light heavy  bus  aadttot
Start
(A20,A10,4F6.3,3I6,I7)
N. Parekh Marg        102   301 5.383 0.231 5.684 0.917  5866   133     0   5999
Sharid Bhagat Singh   102   503 5.383 0.231 6.271 1.492 11700  2233    83  14016
Gen. J. Bhonsle Marg  301   402 5.684 0.917 5.734 1.634 16233   200    33  16466
N. Parekh Marg        301   503 5.684 0.917 6.271 1.492  8066  1133    50   9249
Madame Cama Road      401   402 5.220 1.910 5.734 1.634  7333   616     0   7949
Netaji Subash Road    401   702 5.220 1.910 5.388 2.278 26133   516     0  26649
Madame Cama Road      402   501 5.734 1.634 5.825 1.605 19183  2183    83  21449
Madame Cama Road      501   502 5.825 1.605 6.001 1.589 11383  1016    83  12482
Maharsi Karve Marg    501   704 5.825 1.605 5.854 2.289 14866  2000   166  17032
Mayo Road             502   503 6.001 1.589 6.271 1.492 17233  2783   833  20849
K.B. Patil Marg       502   703 6.001 1.589 6.032 2.312  5866  2050   733   8649
Sharid Bhagat Singh   503   601 6.271 1.492 6.708 2.416 10666   766   500  11932
Mahatma Gandhi Road   503   602 6.271 1.492 6.181 2.274  8583  2333   816  11732
Sharid Bhagat Singh   601   605 6.708 2.416 6.803 2.867 15966  1600   550  18116
Mahatma Gandhi Road   602   603 6.181 2.274 6.062 2.624  7066   583    33   7682
Dadabhai Naoroji Rd   602   604 6.181 2.274 6.459 2.809 13633  3983  1016  18632
Veer Nariman Road     602   703 6.181 2.274 6.032 2.312 16366  2433    50  18849
H. Somani Marg        603   606 6.062 2.624 6.288 2.952  7600   716   566   8882
H. Somani Marg        603   703 6.062 2.624 6.032 2.312 13499  1166   766  15431
Mahatma Gandhi Road   603  1301 6.062 2.624 5.887 3.483 12983   900   233  14116
Mehta Road            604   605 6.459 2.809 6.803 2.867    16  1000     0   1016
Dadabhai Naoroji Rd   604   801 6.459 2.809 6.521 2.988 45833  5083  1383  52299
D' Mello Road         605  1102 6.803 2.867 7.025 4.152 14666   500   616  15782
H. Somani Marg        606   801 6.288 2.952 6.521 2.988  7600   716   566   8882
Veer Nariman Road     702   704 5.388 2.278 5.854 2.289  3466   650     0   4116
Netaji Subash Road    702  1204 5.388 2.278 5.315 3.517 22650   533     0  23183
Veer Nariman Road     703   704 6.032 2.312 5.854 2.289 18000  3250    33  21283
Maharsi Karve Marg    704  1201 5.854 2.289 5.619 3.369 17700  2033    83  19816
Mahapalika Marg       801  1301 6.521 2.988 5.887 3.483 26083  2133   316  28532
```

Figure 2: Traffic data file from Bombay, 'BOMBROAD.DAT'

In the program TRA-WORK traffic data for the main road network is read, and data fields with **road length** and with **traffic work** for the different vehicle groups are written to file. In the program TRA-EMIS these fields are read and multiplied by emission factors to give emission fields. Normally, traffic data will be as AADT, Annual Average Daily Traffic, but may also be morning traffic, afternoon traffic etc.

In this approach to calculate traffic emission fields we have no information about parameters as speed, gradient, cold start and catalyst. These have to be included in the emission factors used in TRA-EMIS. Another program, ROAD-EMI, calculates emission fields from detailed traffic data, but is not included here.

In the PC-model ROADAIR emissions, concentrations and exposure of the population along a defined road network is calculated. The model is developed to give maximum hourly concentrations of CO, NO2 and PM10, but the input data file may be used as input to TRA-WORK with the addition of a reading FORMAT. It is important that the ROADAIR-file also includes the roads outside built-up areas (between villages etc.).

The program TRA-WORK is normally run interactive, but the traffic data are read from file.

Input data to TRA-WORK

KX, KY	Grid dimensions, number of points eastward and northward
NT	Number of vehicle types/traffic fields (max.6)
INFILE	Name of the input file (with apostrophes and .DAT)
OUTFI	Name of the output files (with apostrophes) The data fields will be written binary to the file OUTFILE, the output is written to the file OUTFI.PRN It is useful to use the same family name for INFILE and OUTFILE.
PERIOD, PLACE	With apostrophes
ITRA	Traffic data may exist in three ways: ITRA=1: traffic data for NT vehicle types (max. 6), ITRA=2: total traffic distributed to NT vehicle types, according to the road type, ITRA=3: traffic data from a ROADAIR input file, with % heavy traffic, AADT and daily number of buses. In this case, NT **must** be 3.

Normally, we have information about the traffic composition for only a few roads. But by systematic countings in representative road types it is possible to classify the roads into a few groups, for example: Toll roads, Main arterial roads, Local arterial roads, Roads in industrial areas and Local roads. Some roads may be prohibited for certain vehicles. This grouping has to be done by local people, based upon local knowledge of the traffic.

If NT >1 and ITRA =1 or 2, then

(CART(I), I=1,NT) Name of NT vehicle types, max. 6 (with apostrophes)

If ITRA=2, then

NRT Number of road types (max 5)

(FAD(JR,IT), IT=1,NT) Proportion of the traffic on road type JR by vehicle type IT
One line for each road type JR.

If ITRA=3, the car types will be Light, Heavy and Buses.

UTMX, UTMY	Coordinates of the lower left corner
ISIZE	Grid size in meter (normally 1000 or 500)
ITR	Necessary transformation of coordinates: ITR=0 No transformation ITR=1 Coordinate system should be rotated and translated (see below) ITR=2 The direction of the x-axis should be turned

ITR=3	The direction of the y-axis should be turned
ITR=4	x- and y-coordinates should be interchanged (this may also be arranged by the input format FORMIN)

Sometimes we may get the node coordinates from elsewhere in a other coordinate system than for our calculations, so it is necessary to transform the coordinates by rotation and translation. If ITR=1, coordinates for two reference points in the two coordinate systems are read:

U1F,V1F	Coordinates for ref. point 1 in the FROM-system
X1T,Y1T	Coordinates for ref. point 1 in the TO-system
U2F,V2F	Coordinates for ref. point 2 in the FROM-system
X2T,Y2T	Coordinates for ref. point 2 in the TO-system

The program will ask for a control

YD	Distances between the reference points in the two coordinate systems. OK? Y/N (without apostrophes) If N, read new reference coordinates

As a control, it is useful to print out all road segments within a specified square:

YP	Y/N (without apostrophes)

If YP=Y, enter:

ISQX, ISQY	Indices for the square

Input data for the road network is read from INFILE. The file is read until a line with 'START' or 'Start' in column 1-5. The program halts, and you enter a Return to continue.

Then the program reads a line with input data format FORMIN (with parentheses).
From INFILE the data are read, according to FORMIN, until 'END' in column 1-3 or the end of the file. The input format is depending of the input data:

IF ITRA=1, read:

ROAD, NODES, (POS(I), I=1,4), (ITRAF(I), I=1,NT)

	FORMAT according to FORMIN
ROAD	Road name, 20 characters
NODES	Node numbers 10 characters (used only for road segment identification),
POS	4 node positions,
ITRAF	NT traffic sets, integer (max. 6)

Example: FORMIN= (A20,A10,4F8.3,4I6), reads gives ROAD in column 1-20, NODES in col. 21-30, POS in 31-38, 39-46, 47-54 and 55-62, and ITRAF in 63-70, 71-78, 79-86 and 87-94.

If ITRA=2, read:

ROAD, NODES, (POS(I), I=1,4), TRAFS, JRT

ROAD	Road name, 20 characters
NODES	Node numbers 10 characters (used only for road segment identification),
TRAFS	Sum traffic,
JRT	Road type

Example: FORMIN= (A20,A10,4F8.3,I6,I2), which gives ROAD in column 1-20, NODES in col. 21-30, POS in 31-38, 39-46, 47-54 and 55-62, TRAFS in 63-70 and JRT in col. 71-72.

The traffic will be distributed to the different NT vehicle types according to the factor FAD(JR,IT) for each road type JR.

If ITRA=3, the traffic data are read from a ROADAIR-file. This file type has its own structure, and the program TRA-WORK reads the data according to this.

The traffic will be distributed into LIGHT, HEAVY and BUSES according to:

LIGHT =	ITRAF*(1.0 - (PHEA/100.)),
HEAVY =	ITRA * (PHEA/100.),
BUSES =	IBUS

Example 1:

For the calculation of the traffic work from the main road traffic in Bombay, the following input was used:

```
20,42               , Grid
4                   , 3 vehicle types, plus sum
'BOMBROAD.DAT'      , Traffic data file
'BOMBTRAF'          , Traffic work file
'1990','Bombay'     , Period, place
1                   , using the 4 traffic data sets
'LIGHT','HEAVY','BUS','TOTAL'  Vehicle types
2.0,0.0             , Coordinates of the lower left corner
1000                , Grid size
1.0                 , Scale
0                   , No coordinate transformation
N                   , No print-out of roads
```

The file BOMBROAD.DAT is shown in Figure 2.

The output will be maps of:

Main Road Length
Traffic work Light
Traffic work Heavy

Traffic work Bus
Traffic work Sum.

The program will also give informations about road length and traffic work for roads outside the grid area.

Example 2:

To make fields with traffic from a ROADAIR-file from Pécs we must make some changes to the file as shown in Figure 3: Start and the input format. The data that are read from the file are marked by A, F or I at the top of the file, columns marked by X are not read.

This gives the following input:

42,28	, Grid
3	, 3 vehicle types: light, heavy and buses
'ROADAIR.DAT'	, Input file
'ROADAIR'	, Output file
'1994','PECS'	, Period, place
3	, Reading from a ROADAIR-file
576.0,74.0	, Coordinates of the lower left corner
500	, Grid size
1.0	, Scale
4	, x and y must be changed
Y	, Printout of roads
23,15	, in grid 23,15

The output will be maps of:

Main Road Length
Traffic work Light
Traffic work Heavy
Traffic work Bus

Figure 4 shows a part of the output from the program. The beginning is messages from the reading of the ROADAIR-file: roads that have to be divided for calculation reasons and road segments outside the calculation area. It is mixed with data for the roads in grid (23,15): coordinates, road length and traffic work from light, heavy and buses.

```
  LNR  NAME/VReference         NFra  KT   NTil KT2       X         Y        X2        Y2 GKL      KB      FB      ST   LENGTH   RE  OTY FD      TA       AADT      V    AADTB      MMAX   VMAX   TMAX
BMAX SKL
XXXXXXaaaaaaaaaaAAAAAAAAAAaaaaaaaaaaXXXXXXXXXXxxxFFFFF.FFFfffff.fffFFFFF.FFFfffff.fffXXXXXXXXXXxxxxxxxxxxXXXXXXXXXXxxxxxxxxxxXXXXXXXXXXFF.xxxIIIIIIXXXXXXXXXXiiiii
Start
(6X,A20,A10,13X,4F9.3,50X,F3.0,3X,I6,10X,I5)
    1 KOMLOI UT                                       84500    589500    87000    589100  1     10.      4.      6.    2800.   0   3  2      9.      7837.    50.     282.      649.    40.    10.
15.
    2 6-OS UT SHELL KUTNAL                            82600    589900    83900    590900  1     15.     99.      4.    1250.   0   1  3     11.     16931.    50.     360.     1261.    40.    10.
30.
    3 MOHACSI UT PECS TABLA                           79200    590900    81100    589800  1      7.     99.      4.    2350.   0   1  3      9.      4845.    50.     151.      363.    40.    12.
12.
    4 57-ES - EDISON U.                               79000    589800    79200    590900  1      7.      8.      3.    1200.   0   2  1     11.      6551.    50.      99.      467.    40.    16.
12.
    5 58-AS REMENY PUSZTA                             74600    587100    77200    586900  1      7.     19.      4.    2700.   0   1  3     10.      8827.    60.     209.      649.    50.    14.
17.
    6 MALOM VOLGYI UT PECS TABLANAL                   75500    584800    77200    585800  1      6.      8.      0.    1900.   0   1  3      8.       745.    60.      16.       84.    50.     5.
1.
    7 KESZUI UT PECS TABLA                            76000    583800    77800    585600  1      6.     99.      0.    2700.   0   1  3      7.      4690.    60.      39.      411.    50.     9.
5.
    8 PELLERDI UT                                     77900    580900    80300    580900  1      6.     99.      1.    2400.   0   1  3     18.      3785.    80.      68.      395.    70.    18.
9.
    9 6-OS 26-OS VEGALLOMASNAL                        80000    577700    80300    580900  1      7.     40.      0.    3400.   0   1  3     14.      1363.    80.     149.      815.    70.    18.
9.
   10 ABALIGETI UT 24-ES VEGALLOMAS                   81600    583400    84200    582900  1      6.     99.      2.    2900.   0   1  3      6.      1535.    30.      49.       96.    20.     6.
1.
   11 KOMLOI UT                                       82600    589900    84500    589500  1     12.      2.      4.    1900.   0   3  2     10.     11573.    50.     595.      990.    40.    12.
46.
   12 MOHACSI UT VASUTI ATJ.                          81400    589600    82200    589000  2      7.      2.      0.    2000.   0   3  1     10.     12912.    30.     232.      978.    20.    14.
11.
   13 ZSOLNAY UT MOHACSI UT                           81400    587400    82200    589000  2     18.      2.      1.    2100.   0   3  1     16.     13665.    20.    1325.     1059.    10.    18.
110.
   14 HARSFA UT ENGELS UTNAL                          82250    587800    83250    588600  3      6.      5.      3.    1300.   0   3  5      2.      7930.    50.     103.      763.    40.     2.
10.
   15 LANC UTCA FELSOVAMHAZNAL                        81400    587400    81950    587200  2     10.      6.      2.     800.   0   3  1      4.     15202.    30.     181.     1204.    20.     6.
9.
   16 KALVARIA UTCA                                   82000    586500    82100    586800  2      4.      1.      3.     900.   0   3  2      3.     13965.    40.      20.     1114.    30.     2.
1.
   17 ARADI VERTANOK UTCA                             81950    586100    82000    586500  2      6.     10.      0.     500.   0   2  5      3.     16879.    40.     361.     1418.    30.     3.
29.
   18 KLIMO GY. UTCA                                  81500    586100    81950    586100  2      6.      4.      6.     500.   0   3  2      3.      8347.    30.     156.      834.    20.     2.
14.
   19 RAKOCZI U. 35.                                  81200    586300    81400    587200  2     14.      3.      0.     700.   0   3  2      9.     14313.    30.    1285.     1052.    20.    12.
121.
   20 ALSOMALOM UTCA CINDERI UTCANAL                  81100    587000    81400    587200  2     14.      2.      2.     300.   0   3  2      6.     32797.    40.    1383.     2573.    30.     8.
121.
   21 NAGY LAJOS KIRALY UTJA                          81100    585800    81100    587000  2     18.     12.      0.    1200.   0   3  2      6.     29598.    50.     935.     2237.    40.     5.
83.
```

```
   22 SZABADSAG UT 6.              80700  586400  81200  586300  2  12.   2.  1.   600.  0  3  2   8.   7743.  50.  1230.   611.  40.  20.
114.
   23 ARPADHID                     80000  586800  81100  587000  1  12.  99.  3.  1100.  0  1  4   8.  33007.  50.  1714.  2670.  40.   9.
166.
   24 MARTIROK UTJA 7.             80250  585200  80700  586400  2   7.   6.  0.  1350.  0  3  2   9.   9859.  30.   487.   881.  20.   8.
26.
   25 VERES ENDRE UTCA SZTK.       80300  584300  80250  585200  3  10.   8.  0.   900.  0  3  1   9.  14335.  50.   450.  1127.  40.  10.
35.
   26 HUNGARIA UTCA 19.            81250  585100  81500  586100  2   8.   3.  0.  1900.  0  3  2   7.  13351.  30.   555.  1038.  20.   7.
25.
   27 ATHINAI UT 30.               80900  584950  81150  585500  2   7.   3.  1.   500.  0  3  2   4.  16620.  40.   144.  1210.  30.   5.
13.
   28 ABALIGETI UT                 80800  583500  81600  583400  1   6.   5.  1.  1000.  0  2  2   4.   9152.  40.   126.   546.  30.   4.
10.
   29 SIKLOSI UT                   78200  586900  80000  586800  1  14.   4.  2.  1900.  0  2  2   8.  17643.  50.   773.  1443.  40.   9.
66.
   30 TANCSICS M. 11.              78100  586400  80000  586800  3   7.   5.  0.  2100.  0  3  2   8.  13729.  50.   595.   984.  40.   9.
54.
   31 MALETER PAL UT KRISZTINA TER 77800  585600  78100  586400  3   8.   6.  3.   900.  0  3  2  15.   8958.  40.   750.   789.  30.  17.
71.
   32 TUZER UT FELULJARONAL        79400  585250  80450  585050  3  12.  99.  2.  1400.  0  1  1   4.  23176.  50.   276.  2208.  40.   6.
35.
```

Figure 3: ROADAIR-file from Pécs, 'ROADAIR.DAT''

```
Traffic data are read from the file ROADAIR.DAT
The coordinates of the lower left corner is (576.0, 74.0)
Road KOMLOI UT           ( 27.000 21.000)-( 26.200 26.000) divided in 3 at
                           26.733 22.667
                           26.467 24.333
Road MOHACSI UT PECS TABL ( 29.800 10.400)-( 27.600 14.200) divided in 3 at
                           29.067 11.667
                           28.333 12.933
Road ZSOLNAY UT MOHACSI U ( 22.800 14.800)-( 26.000 16.400) divided in 3 at
                           23.867 15.333
ZSOLNAY UT MOHA 23 15 22.800 14.800 23.000 14.900  .112   1283.0    96.2   148.1
                           24.933 15.867
LANC UTCA FELSO 23 15 22.800 14.800 22.727 15.000  .106   1552.8    45.4    19.3
RAKOCZI U. 35.  23 15 22.000 14.711 22.400 14.800  .205   2668.5      .6   263.3
ALSOMALOM UTCA  23 15 22.000 14.200 22.400 14.800  .361  11115.8   210.6   498.7
Road SIKLOSI UT          ( 21.800  8.400)-( 21.600 12.000) divided in 3 at
                           21.733  9.600
                           21.667 10.800
Road VERSENY UTCA        ( 18.900 12.200)-( 23.800 13.200) divided in 3 at
                           20.533 12.533
                           22.167 12.867
FELSOMALOM UTCA 23 15 22.400 14.800 22.400 15.000  .100    352.8     6.8      .4
RAKOCZI UT ALSO 23 15 22.400 14.800 22.800 14.800  .200   5323.7   351.4   374.4
BAJCSI ZS. U. 9 23 15 22.818 14.000 22.000 14.346  .444   2353.9    14.2   190.1
Road HUNYADI UT 17.      ( 22.800 14.800)-( 20.800 17.400) divided in 2 at
                           21.800 16.100
HUNYADI UT 17.  23 15 22.800 14.800 22.646 15.000  .126    437.0     7.4    35.7
Road SZIGETI UT          ( 15.000 13.600)-( 18.200 14.500) divided in 3 at
                           16.067 13.900
                           17.133 14.200
Road 6-OS MOL KUT        (  9.800 12.600)-( 15.200 12.800) divided in 4 at
                           11.150 12.650
                           12.500 12.700
                           13.850 12.750

Sum  road length in square (23,15) is      1.654 km.
Sum traffic-work in square (23,15) is  25087.490 car-km.LIGHT
                                         732.738 car-km.HEAVY
                                        1529.956 car-km.BUSES
 Field for MAIN ROADS       is put on file ROADAIR.FLD


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        STEI, Pecs, Hungary
         VERSION 2.0, 1-10-1996
         - - - - O O O - - - -

MAP OF : MAIN ROADS        UNIT: KM                 SOURCE: Traffic
PERIOD : 1994             PLACE: PECS           GRID SIZE:  500 METER
CREATED: 1996/10/29 19.05

    MAXIMUM VALUE IS  1.6540E+00, IN (23,15)
                SUM= 1.28626E+02    SCALE FACTOR:  1.0E-03
```

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
J=26	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
J=25	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
J=24	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
J=23	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
J=22	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
J=21	.	.	.	.	.	.	.	.	.	.	.	.	.	204.	.	.	.	.	.	.
J=20	.	.	.	.	.	.	.	.	.	.	.	.	.	326.	183.	.	.	.	.	.
J=19	.	349.	.	.	.	.	.	.	.	.	.	.	.	.	509.	.	.	.	.	.
J=18	.	140.	610.	122.	.	.	.	.	.	.	.	.	.	.	509.	.	.	.	555.	503.
J=17	.	.	.	.	.	356.	304.	.	.	.	.	.	.	.	509.	.	.	.	521.	.
J=16	.	.	.	.	407.	152.	506.	.	.	.	.	.	.	.	508.	.	.	.	573.	521.
J=15	.	.	.	.	.	.	506.	.	.	.	.	.	.	.	504.	.	300.	519.	879.	1020.
J=14	.	.	.	.	.	.	506.	.	.	.	.	.	.	.	202.	967.	864.	1094.	187.	142.
J=13	.	.	.	301.	502.	502.	907.	502.	502.	802.	500.	500.	500.	500.	500.	895.	615.	501.	1280.	902.
J=12	.	.	.	.	.	.	.	.	.	500.	.	.	.	.	.	.	.	.	1009.	.
J=11	.	.	.	.	.	.	.	.	.	500.	.	.	.	563.	309.	.	.	.	202.	350.
J=10	.	.	.	.	.	.	.	.	.	500.	.	.	.	.	253.	563.	274.	.	58.	391.
J= 9	.	.	.	.	.	.	.	.	.	500.	.	.	.	.	.	.	288.	563.	239.	1172.
J= 8	.	.	.	.	.	.	.	.	.	508.	.	.	.	.	.	.	.	.	606.	890.
J= 7	.	.	.	.	.	.	.	.	.	102.	408.	.	.	.	.	.	.	283.	424.	232.
J= 6	.	.	.	.	.	.	.	.	.	.	510.	.	.	.	.	.	283.	424.	220.	360.
J= 5	.	.	.	.	.	.	.	.	.	.	406.	506.	506.	506.	506.	485.	424.	.	580.	.
J= 4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	515.	.	394.	186.	.
J= 3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	206.	309.	.	.	.	.
J= 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	515.	.	.	.	.	.
J= 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	515.	.	.	.	.	.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Figure 4: Part of the output for the traffic in Pécs.

We will have similar maps for the second part of the road field, and fields for traffic work Light, Heavy and Bus. We see that as this was a ROADAIR-file, the road network is not always continuous.

Traffic on small roads

In addition to the emissions from the traffic on the main roads there will always be a lot of traffic on the smaller roads. The traffic work on these will normally be of the order of 15-25 % of the total traffic work, and with emissions of 20-30% of the total. As the amount of information varies from city to city it is very difficult to give a standard procedure for estimating these emissions. One approach is to start with the sale of gasoline, assuming that all gasoline is used within the city region.

By using statistical consumption figures for different vehicle types, and their part of the traffic work on the main roads, it is possible to estimate an upper value for the total traffic work. The difference from the main road traffic work may be distributed according to the population, or according to the population, but with different weight in different regions. This may be done in the program CODE-FIE.

In the URBAIR study of Jakarta it was calculated a traffic work on the main roads of about $14 \cdot 10^9$ car-km, whereas the gasoline consumption figures indicates a traffic work of about $17 \cdot 10^9$ car-km. The difference $3 \cdot 10^9$ car-km/y will be due to traffic on local roads (or error in data). The local traffic work may be distributed by multiplying the population field by $3 * 10^9 / 7.1 * 10^6 = 422.5$ car-km/person.year.

The total traffic work may be calculated by SUM-FIE, as the sum of
'TRAFTOT.FLD' * 1.0, and
'JPOP90.FLD' * 422.5.

This estimate was based upon an average factor for the whole DKI Jakarta. In the densest populated areas the car density is probably lower than in other areas. Based upon local knowledge about the social standard in the different regions of the city it should be possible to define zones with different traffic work *pro capita*.

The average value of 422.5 car-km/person corresponds to about 1.15 km/person*day at local roads. In some zones this should be 0.25 km/day or lower, in other 2.5 km/day and even more.

Program TRA-EMIS

The program is normally run interactive, and it reads one or more fields with traffic work from TRA-WORK and calculates emission fields.

Input data to TRA-EMIS

KX, KY,NTR	Grid dimension, number of points eastward and northward and the number of traffic fields (max. 6)
INFILE	Traffic work file (with apostrophes and .FLD).
ITR	Field number for the first traffic work field. (Normally 2 for files from TRA-WORK, as the first field is the road length.)
OUTFI	Name of the output files (with apostrophes) The data fields will be written binary to the file OUTFI.FLD, the output is written to the file OUTFI.PRN
INFAK	Emission factor file (with apostrophes and .DAT)
(IVE(I), I=1,NTR)	Vehicle type codes on the emission factor file

As a control, it is useful to print out the emission calculations for a specified square:

YP Y/N (without apostrophes)

If YP=Y, enter:
IRUX, IRUY Indices for the square

Emission factors for NCOMP compounds are read from the file INFAK (with apostrophes and .DAT), see the separate description of the emission factor file. The program will prepare NCOMP fields with emissions as a sum of the contributions of each vehicle type.

Example 1:

For calculation of emissions from the traffic fields for Bombay, the input will be:

```
20,42,3            , Grid, 3 traffic fields
'BOMBTRAF.FLD'     , Traffic work file
2                  , First field on the file is the road length
'BO-TR-EM'         , Output file, traffic emissions in Bombay
'EMISFACT.DAT'     , Emission factor file for Bombay
2,4,4              , Using emission factor code 2 for private cars and 4
                   , both for trucks and buses
```

Example 2:

For calculation of emissions from the traffic fields for Central Guangzhou, the input will be:

15,10,5	, Grid, 5 traffic fields
'MAINROAD.FLD'	, Traffic work file
3	, The first two fields on the file are the road length and total traffic
'ROADEMIS'	, Output file, traffic emissions in Guangzhou
'EMISFACT.DAT'	, Emission factor file for Guangzhou
1,2,4,5,6	, Emission factor codes

```
 Program TRA-EMIS reads fields for traffic work from file MAINROAD.FLD
 and makes fields with emission to file ROADEMIS.FLD

 The first traffic work field is no.  3
 Emission factors are read from file EMISFACT.DAT

   4 Vehicle/fuel type   UNIT       DENS      SO2      NOx      CO       Part
   1 Gasoline cars <3.5t g/km       1.000     .050    2.120    9.100     .240
   2 Taxis (old)         g/km       1.000     .060    3.500   10.500     .400
   3 Diesel 3.5-16t      g/km       1.000     .110    7.400    7.300     .820
   4 Heavy diesel truck  g/km       1.000    1.470   14.800    7.300    1.400
   5 Bus                 g/km       1.000    1.350   18.200    6.200    1.200
   6 Motor cycle         g/km       1.000     .080     .080   22.000     .170
   7 Traffic             g/km       1.000     .320    4.830   14.700     .430
  11 Sawdust             ton        1.000     .040    3.000   15.000   10.000
.........................................................................

.........................................................................
  91 Kender (hemp)       ton        1.000     .001     .490   12.190   18.290

 Traffic work field no. 1 uses factors for vehicle type 1
 Traffic work field no. 2 uses factors for vehicle type 2
 Traffic work field no. 3 uses factors for vehicle type 4
 Traffic work field no. 4 uses factors for vehicle type 5
 Traffic work field no. 5 uses factors for vehicle type 6

 TRAFFIC-WORK    CAR-KM LIGHT
     MAXIMUM VALUE IS  4.1915E+04, IN (12, 8)
              SUM= 9.07283E+05

 TRAFFIC-WORK    CAR-KM TAXIS
MAXIMUM VALUE IS  2.1803E+04, IN (12, 8)
              SUM= 4.71930E+05

 TRAFFIC-WORK    CAR-KM TRUCKS
     MAXIMUM VALUE IS  1.1191E+04, IN (12, 3)
              SUM= 3.64463E+05

 TRAFFIC-WORK    CAR-KM BUSES
     MAXIMUM VALUE IS  8.8406E+03, IN (12, 3)
              SUM= 2.87929E+05

 TRAFFIC-WORK    CAR-KM MC
     MAXIMUM VALUE IS  4.8775E+04, IN (12, 3)
              SUM= 1.58849E+06



     Norwegian institute for air research (NILU)
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              Norsk institutt for luftforskning,
                     Kjeller, Norge
                 VERSION 2.0, 15-2-1997
                 - - - - O O O - - - -

 MAP OF :     SO2          UNIT: KG/HOUR           SOURCE: Traffic
 PERIOD : 1995            PLACE: GZ              GRID SIZE: 1000 METER
 CREATED: 1997/07/21 17.09

     MAXIMUM VALUE IS  1.4321E+00, IN (12, 3)
```

SUM= 4.68843E+01 SCALE FACTOR: 1.0E-03

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
J=10	.	.	206.	.	.	28.	199.	.	.	.	590.	840.	354.	.	.
J= 9	.	.	286.	131.	319.	575.	457.	12.	.	100.	1179.	891.	.	.	.
J= 8	.	.	188.	472.	590.	788.	611.	703.	750.	1331.	557.	1181.	324.	324.	311.
J= 7	.	306.	678.	452.	346.	838.	532.	1158.	963.	935.	231.	1231.	638.	589.	576.
J= 6	318.	191.	362.	305.	49.	485.	342.	558.	691.	24.	.	806.	.	.	.
J= 5	30.	231.	71.	584.	501.	491.	577.	.	435.	.	.	846.	.	.	.
J= 4	.	.	160.	435.	106.	530.	384.	787.	472.	.	.	884.	.	120.	158.
J= 3	.	.	.	288.	162.	636.	97.	919.	412.	449.	539.	1432.	450.	217.	.
J= 2	.	.	.	168.	289.	252.	896.	528.	.	.	.	955.	.	.	.
J= 1	.	.	.	166.	282.	.	209.	785.	124.	.	185.	728.	.	.	.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

We get similar maps for NO_x, CO and particles.

If we want to control the emission calculations, we get:

The emissions in grid (15, 4) is:

	Traffic work	SO2	NOx	CO	Part
Gasoline cars <3.5t	2821. car-km	.006	.249	1.070	.028
Taxis (old)	1468. car-km	.004	.214	.642	.024
Heavy diesel truck	1231. car-km	.075	.759	.374	.072
Bus	972. car-km	.055	.737	.251	.049
Motor cycle	5364. car-km	.018	.018	4.917	.038
SUM	11856. car-km	.158	1.978	7.254	.211

Data is put on ROADEMIS.FLD

Program INP-FIE

In this program values for one or more squares may be read to data fields. It is possible to read values for 12 fields at the same time. In the program values may be given for specified squares or areas of squares. The program is normally run as a batch job.

Input data to INP-FIE

KX, KY, NF	Grid dimensions, number of points eastward and northward, and the number of fields (max. 12). If IFI = 3, give NF = 1.
OUTFILE	Name of the output files (with apostrophes). The data fields will be written binary to the file OUTFILE.FLD, the output is written to the file OUTFILE.PRN.
ADD	Shall you add the values in a square (Y/N, without apostrophes)

IFD, IFO, IFI	IFD = 0 reads only NF background values
	1 reads IX, IY and NF values
	2 reads UTM-coord. and NF values
	3 reads rectangles with NF values
	4 reads grid number* and NF values
	* numbering horizontally like
	`73,74,75,.....,84`
	`................`
	`25,26,27,.....,36`
	`13,13,15,.....,24`
	` 1, 2, 3,.....,12`
	for a 12*7-net
	5 reads IX, IY and one value, NFIELD sets
	IFO = 1 reads data **unformatted**
	2 reads data **formatted**
	IFI = 1 reads data from terminal (always formatted)
	2 reads data from file INFILE
	3 reads several fields (each with **one** variable) from file INFILE (NF = 1, IFD = 1)

If IFI = 3, read:

NFIELD	Number of fields to be read

If IFI = 2 or 3, read:

INFILE	Name of the input file (with apostrophes and .DAT)

The file INFILE is opened and read until a line beginning with START or Start (without apostrophes).

Input continues from file or terminal:

PERIOD, PLACE, SOURCE	All with apostrophes
ISIZE, LX, LY	Grid size in meters, grid dimensions

For all NF fields is read:

XB(I), COMP(I), UNIT(I)	XB = Background value
	COMP = Compound name (with apostrophes)
	UNIT = Unit (with apostrophes)

If IFD = 0, NF homogeneous fields with values XB(I) are created.

If IFO = 2, input format is read:

INFORM Input format (enclosed within parentheses, but not apostrophes).

If IFD = 1 or 5, read from file or terminal according to IFO:

IX, IY, (AX(I), I = 1,NF)	IX, IY indices for the square
	AX NF values. If IFI = 3, NF = 1.

Data are read until end of the file or a line with -1,,,,,,

If IFD = 2, read from file or terminal, according to IFO:

UTMX, UTMY	UTM- or local coordinates for lower left corner of the grid
UX, UY, (AX(I), I = 1,NF)	UTM- or local coordinates for the square
AX	NF values

Data are read until end of the file or a line with -1,,,,,,

If IFD = 3, read unformatted:

JX, JY, LX, LY, (AX(I), I = 1,NF)

All squares within the rectangle with lower left corner (JX, JY) and upper right corner (LX, LY) shall have the values AX.
A rectangle may cover one single square or many squares. For each rectangle the program asks if we want more rectangles Y/N (without apostrophes), until the answer is N.

If IFD = 4, read from file or terminal:

IGR, (AX(I), I = 1,NF)	IGR = grid number
	AX NF values

Data are read until end of the file or a line with -1,,,,,,

When all data are read, the program asks when IFI = 1 or 2:

```
Do you need to re-scale the data? Y/N.
```

If the answer is Y, NF scale factors are requested, and the values read are multiplied by this.

SCALE(I), I=1,NF Scale factore for the data

Finally the program asks for scaling of the print-out:

ISC	1	No scaling (the values are printed as they are)
	2	Automatic scaling
	3	New scale factors (be careful!)

If ISC = 3, NF new scale factors are read:

CSC(I), I=1,NF Print-out scale factors

Example for input to INP-FIE

In TESTPLACE we want to adjust emission fields at the file TESTHEAT.FLD for 2 planned central heating networks as indicated in the figure below:

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
J=16	3.	3.	.	.	.	.	.	.	.	.	.	.	.	.
J=15	4.	3.	.	.	10.	.	4.	18.	14.	.	.	.	20.	33.
J=14	6.	11.	11.	9.	14.	31.	19.	17.	17.	.	.	13.	37.	41.
J=13	20.	33.	19.	9.	30.	31.	29.	37.	25.	20.	16.	32.	23.	27.
J=12	30.	32.	21.	21.	22.	42.	67.	104.	39.	32.	28.	24.	12.	45.
J=11	22.	17.	17.	28.	51.	60.	92.	55.	20.	28.	8.	1.	43.	23.
J=10	28.	47.	17.	74.	157.	98.	97.	49.	16.	14.	7.	28.	28.	14.
J= 9	19.	6.	20.	83.	48.	48.	64.	80.	22.	33.	34.	20.	25.	.
J= 8	.	1.	10.	2.	7.	1.	15.	54.	20.	26.	45.	25.	5.	.
J= 7	4.	6.	10.	.	.	.	1.	20.	23.	28.	49.	45.	.	.
J= 6	.	.	.	.	.	.	4.	11.	18.	33.	18.	33.	.	.
J= 5	.	.	.	.	.	.	2.	15.	22.	39.	18.	25.	9.	.
J= 4	.	.	.	.	.	.	2.	6.	30.	45.	42.	25.	.	.
J= 3	.	.	.	.	.	.	2.	.	41.	30.	29.	10.	.	.
J= 2	.	.	.	.	.	.	.	2.	34.	1.	4.	3.	.	.
J= 1	.	.	.	.	.	.	.	9.	18.	3.	4.	1.	.	.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14

We want to prepare a mask to adjust the emissions within the areas indicated above:

C:\KILDER\INP-FIE

14,16,1	grid dimensions, 1 field
'CENTMASK'	output file name
N	no addition of values
1,2	reads IX, IY from a separate file

'CENTHEAT.DAT' input file name
N no re-scaling of data
2 automatic scaling of output

From the file 'CENTHEAT.DAT' is read:

START
'2000','TESTPLACE','CENTRAL HEATING'
1000 grid size
1,'PLANT','INTEGER', background, compound, unit
2,10,2
2,11,2
3,10,2
3,11,2
3,12,2
9,8,3
10,6,3
10,7,3
10,8,3
10,9,3
11,6,3
11,7,3
11,8,3
11,9,3
12,7,3
-1,,,,,

The program CODE-FIE may be used to reduce the emissions from the file TESTHEAT.FLD according to the area codes in the file CENTHEAT.FLD.

The file TESTHEAT might also be read interactive (IFI = 1) as a combination of rectangles:

2,10,3,11,2
Y
3,12,3,12,2
Y
10,6,11,9,3
Y
9,8,9,8,3
Y
12,7,12,7,3
N

Another way to reduce the emissions is to prepare a mask which later shall be used in PROD-FIE:

```
C:\KILDER\INP-FIE
14,16,1             grid dimensions, 1 field
'CENTMASK'          output file name
N                   no addition of values
1,1                 reads IX, IY and values from the terminal
'2000','TESTPLACE','CENTRAL HEATING'
1000                grid size
1.0,'MASK','FACTOR',background, compound and unit
2,10,-0.15
2,11,-0.83
3,10,-0.75
3,11,-0.66
3,12,-0.22
9,8,-0.75
10,6,-0.50
10,7,-0.75
10,8,-0.80
10,9,-0.60
11,6,-0.40
11,7,-0.90
11,8,-0.85
11,9,-0.50
12,7,-0.50
-1,,,,,
N                   no re-scaling of data
2                   automatic scaling of output
```

There is a background of 1.0, and in the squares covered by the central heating network the emissions will be reduced according to the values. This mask will be multiplied by the emission field in the program PROD-FIE.

Program CONS-FIE

This program reads data about the **consumption** of fuels as oil, coal, wood or other, mainly for domestic use, and makes consumption fields. In the program CONS-EMI these data are multiplied by emission factors to make **emission** fields.

Originally CONS-FIE was written to give maps for an emission survey. Consumption data for a list of point sources was read, and the consumption for a large number of consumers was combined to area sources. In addition to this, there was a rest-consumption which had to be distributed in different ways, mainly according to the population distribution. In most cases detailed consumption figures are not available, and this part is taken out of this version of the programme CONS-FIE. If consumption data for point or area sources are available, these may be read to fields by INP-FIE.

The consumption may be given as a total for the whole area, as separate data for different regions, or as *pro capita* consumption figures. In a region the different zones may have a varying social standard with unlike specific consumption. As domestic heating may be the dominant source of air pollution in many regions, it is important to have a realistic model for the consumption. The more local knowledge that is the basis for the estimates, the better will the result be.
The program is normally run interactive. It may be necessary to run it twice or more, because it asks for data that may be not are available in advance, but are calculated by the programme.

Input data to CONS-FIE

KX, KY	Grid dimensions, number of points eastward and northward
OUTFI	Name of the output files (with apostrophes). The data fields will be written binary to the file OUTFI.FLD, the output is written to the file OUTFI.PRN
PERIOD, PLACE, SOURCE	All with apostrophes
NFUEL	Number of fuel types (max. 8)

For each fuel type is read (with apostrophes):

TYPE, UNIT	TYPE = fuel type (COAL, WOOD, KEROSENE, FUEL OIL etc.) UNIT = unit (tons/year, m^3/year etc.)
NZO	Number of zones for distribution of the consumption (max. 9)
POPFILE, ZONEFILE	Names of the files with population and zone codes (with apostrophes and .FLD, or 'NONE') If POPFILE = 'NONE', all squares are given weight = 1 If ZONEFILE = 'NONE', then NZO **must** be 1 Only one file name can be 'NONE'

The program counts the number of squares in each zone group if POPFILE = 'NONE', otherwise the number of inhabitants in each zone group, IPOPU. Here we may proceed in two ways:

IDIS	IDIS=1 Total consumption is distributed according to a weighted population distribution IDIS=2 Total consumption is calculated from consumption pro capita in different zones

If IDIS = 1, for each fuel type K is read:

(ALL(K,L), L=1,IZO)	Total amount of fuel type K consumed in each zone. The consumption in square (I,J), which belongs to zone L is calculated as CONS(I,J,K)=ALL(K,L)*POP(I,J)/IPOPU(L)

If IDIS = 2, for each fuel type K is read:

(CAP(K,L), L=1,IZO)	Pro capita consumption of fuel type K in each zone The consumption in square (I,J), which belongs to zone L is calculated as CONS(I,J,K)=CAP(K,L)*POP(I,J)

Example:

In example 2 to READ-FIE we have read a field with zone codes called TESTAREA.FLD. We want to distribute consumption figures according to the population, which is at the file POPU85.FLD. (The figures are not real.)
This gives the following input to CONS-FIE:

14,16	Grid dimensions
TESTCONS	Fields at TESTCONS.FLD, output at TESTCONS.PRN
'1985','OSLO','DOM. HEATING'	Period, place and source 3 fuel types
'WOOD'; 'tons/y' 'DIST.OIL','m^3/y' 'HEAVY OIL','m^3/y'	Fuel types, unit
8	8 zones. Population data for zone 9 was not included at POPU85.FLD, and no fuel is allocated to this area.
'POPU85.FLD','TESTAREA.FLD'	Population and zone file
1	IDIS=1, fuel consumption for each zone is read

```
3218,2456,385,          zone 1
 416,1509, 82,          zone 2
1796,6958,436,          zone 3
2619,5077,562,          zone 4
3055,7603,812,          zone 5
 812,1285,409,          zone 6
2628,3329,756,          zone 7
 897,1018,318,          zone 8
```

Consumption of 3 fuel types, 8 zones

This gives the following output to the file TESTCONS.PRN:

```
Population in each zone group:
   1  30650
   2  88590
   3  31770
   4  10220
   5  18850
   6  77690
   7  56690
   8  54840
```

```
Data is put on file TESTCONS.FLD

MAP OF WOOD          UNIT: tons/y       PERIOD: 1994        PLACE: TESTPLACE

MAXIMUM VALUE IS  1.2019E+03, IN ( 2,10)
            SUM= 1.54410E+04       SCALE FACTOR:  10

GRID SIZE:  1000 METER

          1    2    3    4    5    6    7    8    9   10   11   12   13   14

 J=16    2.   2.    .    .    .    .    .    .    .    .    .    .    .    .

 J=15    2.   2.    .    .  15.    .   7.   2.   1.    .    .    .   2.   3.

 J=14    3.   6.   6.   5.  22.  50.  31.   2.   2.    .    .   1.   4.   4.

 J=13   11.  19.  11.   5.  48.  50.   1.   4.   3.   2.   2.   3.   2.   3.

 J=12   17.  18.  12.  12.  36.   2.   3.  11.   4.   3.   3.   3.   1.  21.

 J=11   12.   9.   9.  45.   2.   3.   4.   3.   2.   3.   1.    .  20.  11.

 J=10   16. 120.  44.   3.   7. 103. 102.   2.   2.   2.   1.  13.  13.    .

 J= 9     .  16.  52.   4.   2.  50.  68.   4.   2.   3.  16.   9.    .    .

 J= 8     .   4.  25.    .    .    .   2.   9.   3.  12.  21.  12.    .    .

 J= 7     .    .    .    .    .    .    .   3.   4.  13.  23.  21.    .    .

 J= 6     .    .    .    .    .    .   1.   2.   3.  15.   8.  15.    .    .

 J= 5     .    .    .    .    .    .    .   2.   4.   6.   8.  11.    .    .

 J= 4     .    .    .    .    .    .    .   1.   5.   7.   7.    .    .    .

 J= 3     .    .    .    .    .    .    .    .   7.   5.   5.    .    .    .

 J= 2     .    .    .    .    .    .    .    .   6.    .   1.    .    .    .

 J= 1     .    .    .    .    .    .    .   1.   3.   1.   1.    .    .    .

          1    2    3    4    5    6    7    8    9   10   11   12   13   14
```

and similar fields for DIST. OIL and HEAVY OIL.

Example 2:

From the example above we have data for the consumption and the population within the 8 zones. This enables us to calculate a specific wood consumption factor CAP in tons wood pr. year per person:

```
Zone      1       2       3       4       5       6       7       8
Cons. 0.1050  0.0047  0.0565  0.2563  0.1621  0.0105  0.0464  0.0164
```

In the same way we may calculate consumption per person for other fuels. It will perhaps be easier to estimate a consumption in kg or liter per day, but it has to be transformed to consumption per year/person.

Errors

In a program system you will always sooner or later come into trouble with error messages, or, what is worse, the program halts without any message. The main reason for this is **wrong input data**, or a **wrong description of input data**. For a program system as KILDER which has been in use for many years, there shall not be any programming errors left.

During writing the program code we are always trying to give the user as much information as possible in order to avoid that the program stops. If you are missing an apostrophe in a file name, the programs will ask again, if the file does not exist you will get a message of this. But it is difficult to be 100 % waterproof. Sometimes the answers to the programs are stupid, and it is impossible to protect against this. In some cases, an error can occur, but the result of the error will appear in another part of the program. Some of the programs has the possibility to read input data according to a read FORMAT specification, and things may go wrong.

When the program stops, you will often get an error message of the following general form, with an error code number rangeing from F6000 to F6999:

`run-time error F6xxx : operation` *`filename`* `- messagetext`

The most frequent operation code will be OPEN or READ of the file with the filename given, and from the messagetext it should be possible to detect the error. The following list gives some of the messages, as they are presented in the FORTRAN Reference Manual:

F6100 **INTEGER overflow on input**. An integer can normally be in the range -32.767 to +32.767. If a comma between two integers when you are reading data unformatted is missing, the numbers can be too high.
F6101 **invalid INTEGER**. An illegal character appeared as part of an integer.
F6103 **invalid REAL**. An illegal character appeared as part of a real number.

F6205 **A edit descriptor expected for CHARACTER**. The **A** edit descriptor was not specified when a character data item was read or written using formatted I/O.
F6206 **E, F, D or G edit descriptor expected for REAL**. The **E**, **F**, **D** or **G** edit descriptor was not specified when a real data item was read or written using formatted I/O.
F6207 **I edit descriptor expected for INTEGER**. The **I** edit descriptor was not specified when an integer data item was read or written using formatted I/O.

F6413 **file already connected to a different unit**. The program tried to connect an already connected file to a new unit. A file can be connected to only one unit at a time.

F6416 **file not found**. An OPEN statement specified STATUS='OLD' for a file that does not exist.

F6501 **end of file encountered**. The program tried to read more data than the file contains.

F6504 **invalid number in input**. Some of the values in a list-directed input were not numeric. The following example would cause this error:

```
123abc
```

F6505 **invalid string in input**. A string item was not enclosed in single quotation marks '.

F6980 **integer expected in format**. An edit descriptor lacked a required integer value.

F6981 **initial left parenthesis ecpected in format**. A format did not begin with a left parenthesis (.

F6987 **'.' expected in format** No period appeared between the *w* and *d* fields of a **D**, **E**, **F** and **G** edit descriptor.

F6988 **unexpected end of format**. An incomplete format was used. Improperly matched parentheses, an unfinished Hollerith (**H**) descriptor, or another incomplete descriptor specification can cause this error.

F6989 **unexpected character in format**. A character that cannot be interpreted as part of a valid edit descriptor was used in a format.

Another run-time errors:

M6101 **invalid**.An invalid operation occurred. This error usually occurs when operating on a NAN (not a number) or infinity, very often as a result of a division by zero.

R6003 **integer divide by 0**. An attempt was made to divide an integer by 0, giving an undefined result.

Unfortunately, the computer is not able to tell us which variable that gives the value 0.