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Mikkelsen, Torben

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RISØ-M-2361

DESCRIPTION OF THE RISØ PUFF DIFFUSION MODEL

Torben Mikkelsen

Abstract. The Risø National Laboratory, Roskilde, Denmark, atmospheric puff dispersion model is described. This three-dimensional model simulates the release of Gaussian pollutant puffs and predicts their concentration as they are diffused and advected downwind by a horizontally homogeneous, time-dependent wind. Atmospheric characteristics such as turbulence intensity, potential temperature gradient, buoyant heat flux and maximum mixing depth have been considered.

INIS descriptors: ADVECTION; AIR POLLUTION; BOUNDARY LAYERS; CLUSTER EMISSION MODEL; COMPUTERIZED SIMULATION; DIFFUSION; EARTH ATMOSPHERE; HEAT FLUX; METEOROLOGY; PLUMES; SPATIAL DISTRIBUTION; TEMPERATURE INVERSIONS; TRAJECTORIES; TURBULENCE; WIND

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1. INTRODUCTION

The downwind transport and distribution of atmospheric pollutants from a isolated source over land or water has become an important environmental factor in today's society. The need to understand the distribution of smoke, unpleasant or potentially harmful foreign gases and perhaps radioactive debris from a nuclear power plant accident are becoming more and more essential for industrial operations and construction planning. The dispersion of such atmospheric pollutants is commonly modeled by a standard Gaussian plume model which computes one-hour average plume characteristics.

The Meteorology Section of the Risø National Laboratory, Roskilde, Denmark, has recently developed a puff model for prediction and simulation of atmospheric pollutant diffusion.

The model considers individual puffs of pollutants with specific release rates that are advected by a horizontally homogeneous wind over a grid. The wind input may be either the measured wind from a single point, a spatial average or a wind simulation. The model simulates the instantaneous plume characteristics by adding a group of puffs, growing in size, as they advect with the wind. A Gaussian plume model, on the other hand, provides a time averaged concentration pattern based on a single time average wind vector. In the puff model, the plume advects with a time series of actual wind data. Thus, the puff model is able to predict time varying concentration distributions in actual changing wind conditions, making it an appropriate tool for dynamical computations of downwind dispersions of pollutants.

A basic comparison of a puff model simulation and a typical plume is illustrated in Fig. 1. Looking from above, the instantaneous behaviour of a plume being advected from a source by the wind is shown. The outer cone-shaped contours represent the outer limit of the plume boundary and are identical in both Figs. 1 (A) and (B).

Fig. 1. Instantaneous behaviour of typical plume and a series of puffs from a puff model.

Fig. 1(A) shows an instantaneous depiction of an actual plume. The long-term average plume concentration is shown on the extreme right as a smooth curve with a maximum on the central axis. Also shown is the instantaneous plume concentration considered realistic but is of such a short time scale that it cannot be predicted or easily measured.

The puff model prediction is depicted in Fig. 1(B). The circles show the boundaries of individual puffs of pollutants released from the source. These puffs are advected and diffused downwind by a frequently updated wind. The long term average concentration prediction of the puff model is expected to be identical to the long term concentration of Fig. 1(A). The short term average pollutant prediction, a Gaussian curve shown on the extreme right, is not completely realistic but is a reasonable approximation to the instantaneous plume concentration profile.

2. RISO PUFF MODEL

2.1 General characteristics

The Riso puff model is a three-dimensional computer model used for the prediction and/or simulation of the diffusion and advection of atmospheric pollutants. The puff model technique is to simulate a plume with Gaussian shaped puffs with specified release rates within a specified grid. The initial size of the puffs is normally one meter in diameter although this can be easily adjusted. The amount of material in a puff is the release rate times the elapsed time between puffs. Therefore, a long elapsed time between puff releases results in a higher initial puff pollutant concentration than a short time interval. This should not normally be of concern if an adequate balance is maintained between grid size, advection speed and puff release

The location of the puffs on the grid is determined by computing their movement for a finite time step using a measured wind field. The growth and buoyancy of the puffs are computed from simultaneous specifications of atmospheric turbulence intensity and stability and from buoyant heat flux at the source. An inversion cap through which pollutants cannot pass and the source height where pollutants are released are variable and can easily be adjusted. Grid distances within the model may vary from meters to kilometers and time durations from seconds to hours are possible.

This puff model has the capability of monitoring a maximum of twenty-five sources of puffs and its grid may contain up to 100 puffs. A puff source can be located anywhere on the grid and have a unique release rate, start and stop of release time, and heat production. When the center of a puff moves outside the boundaries of the grid (either horizontally or vertically), that particular puff is dropped from memory. In this way the model does not store irrelevant puff information, thus keeping computer memory requirements to a minimum.

A variable to control the amount of reflection/absorption of the pollutant by the surface is easily adjusted in the puff model. Such a parameter is of great value both in actual dispersion problems and also for gaining understandings of the plume/surface relationship.

The model calculates the concentration at each grid point by summing the contributions from surrounding puffs for each advection step. The grid concentrations can be allowed to accumulate or simply be updated with the latest instantaneous value. A minimum grid concentration of interest can be set to reduce computer run time by dropping concentrations too small to be of interest.

The output of the model contains periodic results of puff locations and concentrations as well as initial input verification. The time interval for the periodic results is adjusted by the input data. This recurrent lineprinter output contains:

- X-Y plane plots showing the position of the sources and of puffs inside the grid,
- X-Z plane plots of puff positions for evaluating plume rise for each vertical level of interest, and
- a table listing of the grid point concentrations for each level.

A computer drawn contour of the magnitudes of the pollutant concentrations is also available.

When considering distance between gridpoints ($\Delta X, Y, Z$), only spatial resolution and computer resources need be considered, calculated concentrations accuracy is not related to the grid-point separation. To ensure that no essential information on individual puffs is "hidden" between grid points, the grid separation should be adjusted dependent upon the size

of the puffs at the downwind distance of interest. Other specific model configuration considerations are described in the following sections. They are also discussed in more detail in the model behaviour chapter.

2.2. Wind field

Once a puff is released, it is advected based upon wind data measurements at a single point only, normally the release point. This limits the validity of the model to situations where the wind field and turbulence can be assumed to be horizontally homogeneous throughout the grid. It is therefore important to ensure that the data obtained from such a single point measurement is representative of the wind structure for the whole area of interest.

The wind data are normally obtained in the form of a horizontal velocity time series. A vector sequence is formed by averaging over a convenient interval. These data are read into the model after being segregated into turbulence classes as discussed in the next section.

2.3 Turbulence intensity and diffusion

The growth/diffusion of a puff depends upon the turbulence intensity. To account for this growth, the puff model applies the theory for relative diffusion suggested by Smith and Hay (1961).

The turbulence intensity is defined to be the standard deviation of the wind direction (in radians) squared. These standard deviation values are collected for the same short time periods as the wind speed measurements used to advect the puffs. Therefore, the intensity of the turbulence which governs the relative diffusion of the puffs, can be adjusted along with the advecting wind speed after each time step, if the stability conditions changes.

A very low value of turbulence intensity represents a small standard deviation, normally a stable atmosphere and a weak puff dispersion/diffusion. As the atmosphere becomes more unstable, the turbulence intensity increases along with an increase of the wind direction standard deviations and plume dispersion/diffusion. While these characteristics are representative of turbulence over land, they can be applied to over water cases in a broad sense.

2.4 Plume rise

In the vertical direction, puff-rise can be accounted for by Briggs (1970) plume rise theory. In this case buoyancy is assumed to be conserved (adiabatic motion), and pressure forces, molecular viscosity and local density changes are considered small and are neglected. The rate at which a puff rises as it is advected downwind is a function of the buoyancy flux, wind speed, puff distance travelled and stability of the atmosphere. Plume rise is considered separately for each individual puff.

2.5 Reflection

The interaction of the pollutant with the surface is adjustable and can be easily changed in the input data. Total reflection or absorption or a fraction between the two can be used.

2.6 Limit of mixing depth

The effect of an atmospheric lid (inversion) can be applied in the model to limit the vertical movement of the pollutant. The model does not permit the plume to rise above this cap. When a mixing level is in effect, it acts to totally reflect the pollutant in the same manner as total reflection at the surface. This mixing cap also acts as an inversion limiting the vertical diffusion of a non-buoyant puff.

3. ACKNOWLEDGMENT

Stephan K. Rinard, The Naval Postgraduate School, Monterey, California is grateful acknowledged for, in connection with his master thesis: "An analysis of a puff dispersion model for a coastal region", to significantly improve the previous description of the Riss puff model (Mikkelsen, T. (1979) Simulation of obscuration smoke diffusion, 73 pp).

4. REFERENCES

- Mikkelsen, T. (1979). Simulation of obscuration smoke diffusion. Work done under contract to the Danish Defence Research Establishment/Riss, 73 pp. Available from: Meteorology Section, Physics Department, Riss National Laboratory, DK-4000 Roskilde, Denmark.
- Rinard, S.K. (1982). An analysis of a puff dispersion model for a coastal region. Master's Thesis from Naval Postgraduate School, Monterey, California, 88 pp.

APPENDIX A

Major Sections of the puff model

The Risø puff model code has previously been described Mikkelsen, T. (1979). The code also is well documented with comment statements. With that information and the outline to be provided in this and the following appendices, the computational and input/output procedures will be obvious.

The program and input data are stored on cards for the sake of permanency. For efficient operational execution, the program and input data cards are read on a disk within the computer. The model can then be run at will without reference to the original data cards. Minor changes can easily be made directly on the disk both to the model and/or data before each execution.

The model can be separated into the following main sections:

- a) Input data
- b) Initial
- c) Calculating
- d) Output
- e) Error diagnostics
- f) Subroutines

These will be described separately in the following sections.

A. Input data section

The input data includes the variables shown in Table IV.

Table IV

Input Data Variables for the Puff Dispersion Model

Wind History	Potential Temperature Gradient
Turbulence Intensity	Buoyant Heat Flux
Grid Dimensions	Minimum Concentration of Interest
Mixing Depth	Reflection at Ground Level
Source Locations, Start/Stop Time, Strength, Heat Emission,	
Number of Seconds between Advection Steps	
Number of Seconds between Printouts/Plots	
Number of Seconds between Puff Releases	

The wind field and stability class for the current time step are read at the start of the calculation section.

The variables listed above are printed as input data check and a permanent record to accompany the actual output. In most cases the print command can be overridden by YES/NO options.

B. Initial section

Based upon the input data from section (A), the initial section specifies and initializes parameters to be used in the calculating section and is passed only once during execution of the model. The grid and some counters are initialized. Constants relating to reflectance, mixing depth and stability as well as those controlling the size of some of the loops within the model are established. Parameters such as number of puff releases per second, number of advection steps per second and number of advectionb steps per puff release are determined.

C. Calculation section

Using current wind and stability class data read at the start of the calculation section, the model advects the puff centers and calculates the growth rate and plume rise of the puffs. It removes the puffs that have left the grid (horizontally and/or vertically). The predicted concentration is computed at the grid points to include pollutants from all nearby puffs.

D. Output section

For time intervals designated by the input data, printer plots of the X-Y and Y-Z grid are produced. A maximum mixing level is marked on the Y-Z grid if in effect.

These plots include the source location and a trace of the plume from the release time to the maptime. Also printed at this interval is a X-Y table of grid concentrations for each vertical level of interest. These concentrations can be either accumulated or actual concentrations at the plot time.

Added to the puff model is a versatile plotter routine to smooth and contour the grid magnitude concentrations of the above tables.

E. Error Diagnostic section

If the model is directed by the input data beyond the limits of the design of the program, the program is terminated by way of the error diagnostic section. It prints comments relating to the commonly made input errors enabling the user to isolate problems.

F. Subroutines

The subroutine "Sigris" calculates the puff size in the horizontal and vertical directions. It also estimates plume rise associated with pollutant buoyancy.

The subroutines "Ispace" and "Rspace" are used in the framework of the printer plots.

The subroutine "Plout" converts the plume concentrations to a logarithmic values, smoothes and then contours them using Rise inhouse contour subroutines. The values are converted to their logarithm values so that the problem of contouring over many orders of magnitude is simplified.2A

APPENDIX B
PUFF MODEL FLOW CHART

APPENDIX C

Puff Model Concentrations

CHEMIN -- Minimum grid concentration of interest
DELX, DELY, DELZ -- Distance in meters between grid points
DOSE -- Allows the concentration matrix to accumulate
DTDZ -- Potential temperature gradient (K/m) (.GE. 0)
HEAT -- Individual source heat emission (KWatt)
ICOLS -- Number of columns in grid (.LE. 10)
INST -- Instantaneous concentration matrix
ITIME -- Start time
JROWS -- Number of rows in grid
KPLANS -- Number of vertical levels in grid (includes surface)
MAPTIM -- Number of seconds between printer plots
NRELSE -- Number of seconds to stop of release
NRMULT -- Number of sources (.LE. 25)
NTADV -- Integer number of seconds between advection steps
REFLEC -- Reflection at ground level (0. none; 1.0 total)
SOURNR -- Number to identify source
SOURST -- Strength for individual source (g/s)
STOPRL -- Individual source stop time (s)
STRTRL -- Individual source start time (s)
TAU -- Integer number of seconds between puff releases
TURN -- Angle of rotation of wind direction
XSOURCE -- X coordinate of source in grid units
YSOURCE -- Y coordinate of source in grid units
ZM -- Limited mixing depth (m)

```
// EXEC PGM=IEBGENER
```

```
//SYSPRINT DD DUMMY
```

```
//SYSIN DD DUMMY
```

```
//SYSUT2 DD UNIT=SYSDA,DISP=(NEW,PASS),
```

```
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=6400),
```

```
// SPACE=(TRK,(1,1)),DSN=&FTO2
```

```
//SYSUT1 DD *
```

```
WIND DATA SEPT 29 81
```

```
810929 1630 #1800#
```

```
/D
```

```
" 085*04.7" 085*04.8
```

```
/
```

```
// EXEC FRTXCLGN,NAME=CONRECQC
```

```
//FORT.SYSPRINT DD DUMMY
```

```
//FORT.SYSIN DD *
```

```
CCFILE 1(KIND=DISK,TITLE='PRINDA',FILETYPE=7)
```

```
CCFILE 2(KIND=DISK,TITLE='VINDDA',FILETYPE=7)
```

```
CCFILE 3(KIND=DISK,TITLE='STABDA',FILETYPE=7)
```

```
CCFILE 4(KIND=DISK,TITLE='SOURCEDA',FILETYPE=7)
```

```
CCFILE 5(KIND=DISK,TITLE='INTSDA',FILETYPE=7)
```

```
CCFILE PRINT(KIND=PRINTER,FILETYPE=7)
```

```
CCFILE 6(KIND=PRINTER,FILETYPE=7)
```

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APPENDIX D

LISTING OF PUFF MODEL COMPUTER CODE

THIS MICRODIFFUSION PROGRAM REPRESENTS THE STATE-OF-
THE-ART CONCERNING THE DEVELOPMENT OF A NUMERIC DIFFUSION
MODEL FOR OBSCURATION SMOKE. (RISO, MET. SEC. SEPT 1978)

THE PROGRAM IS DOCUMENTED BY HEAVY USE OF COMMENT STATEMENTS.

FOR COLLECTING AN OVERALL VIEW OF THE PROGRAM STRUCTURE, AS
WELL AS TO SET UP INPUT DATA FILES, IT IS ADVISED TO
CONSULT THE FLOWCHARTS AND DESCRIPTIONS IN THE CONSECUTIVE
REPORT.

COMMON HEATFX(25),I2,DMS,POINT,INTENS(14),STABPA,FBUFLX

1 SPEED, CONST1,DELZ

1 INTEGER TAU,POINT,ANGLE,XSB,XLB,YSB,YLB,ZSB,ZLB,YINT,XINTPF,YLINE

1,ZMG,ZINTPF,WINDAV,TOTTM,SUMPUF,SOURNR,TPUFFS(25),XINT(100)

1 INTEGER XSOURC(25),YSOURC(25),STRTRL(25),STOPRL(25)

LOGICAL LINE,COINCD,NOMXDP,GRRFLX

DIMENSION STRING(105),HORFRM(105),VERFRM(105),IRFRMZ(105),VRFRMZ(1

105),VERPLS(105),VRPLSZ(105),PARENT(105),NBUF(7),SBUF(7)

REAL BL/' /,SN1/' * /,SN2/' /,SN3/' + /,SN4/' - /,SN5/' | /,SN6/' ' /

PUF00010

PUF00020

PUF00030

PUF00040

PUF00050

PUF00060

PUF00070

PUF00160

PUF00170

PUF00180

PU00190

PU00200

UF00210

PUF00220

PUF00230

PUF00240

PUF00250

PUF00280

PUF00310

PUF00320

PUF00340

PUF00350

PUF00360

PUF00370

PUF00380

UF00390

PUF00410

PUF00420

PUF00430

PUF00440

	DIMENSION TITLE(18),WINDTX(18),PUFFTX(18),INTSTX(18),STABTX(18)	PUF00450
	DIMENSION PTABEL(25,100,7),SHIFT(100,7),CHI(50,50,10)	PUF00460
	DIMENSION ABC(10),SOURST(25),CPLOT(10,17),SOHT(25)	PUF00480
	REAL DATA(14),TYPE(14),INTENS	PUF00500
		UF00510
	DATA NO/'NO'/,BLANK/' '/,A/'A'/,B/'B'/,C/'C'/,D/'D'/,E/'E'/	PUF00540
	DATA PUNK/'.'/,ASTER/'*'/,ANFO/'#'/,SLASH/'/'/,DOSE/'DOSE'/	PUF00550
	DATA AA/'#'/	PUF00560
C	*****	PUF00570
C	*****	PUF00580
C	*****INPUT DATA SECTION*****	PUF00590
C	*****	PUF00600
C		PUF00610
C	INPUT DATA FROM DATA FILE PRIMDATA:	PUF00630
C	PRIMARY DATA FOR PUFF MODEL	PUF00640
C		PUF00650
C	READ PRIMDA,CARD NO. 1:	PUF00660
C	READ(1,10) ITIME,NRELSE,NSTEPS,ICOLS,JROWS,KP.ANS,NTADV	PUF00670
C	READ PRIMDA,CARD NO. 2:	PUF00680
C	READ(1,20) MAPTIM,TAU,TURN	PUF00690
C	READ PRIMDA,TITLE STRING:	PUF00700
C	READ(1,30) TITLE	PUF00710
C	READ PRIMDA,CARD NO. 4 - 5:	PUF00720
C	READ(1,40) DELX,DELY,DELZ,CHEMIN,REFLEC	PUF00730
C	READ PRIMDA,CARD NO. 5-9:	PUF00740
C	READ(1,50) ABC(5),ABC(6),ABC(7),ABC(8),ABC(9)	PUF00750
C	END OF PRIMDA - INPUT FILE.	PUF00760
		PUF00770
		PUF00780
	1 FORMAT(2H0)	PUF00810
	2 FORMAT(2H1)	PUF00820
	10 FORMAT(7I5)	PUF00830
	20 FORMAT(5I5)	PUF00840
	30 FORMAT(18A4)	PUF00850
	35 FORMAT(1H ,18A4)	PUF00860
	40 FORMAT(3F10.2,1E10.4,1F10.5)	PUF00870
	50 FORMAT(A2/A2/A2/A2/A4)	PUF00880
	100 FORMAT(6X,31HKEY PARAMETERS FOR CURRENT RUN:)	PUF00890
	200 FORMAT(6X,13HITIME = ,15,6X,13HNRELSE = ,15,6X,13HNSTEPS	PUF00900
	1= ,15)	PUF00910
	300 FORMAT(6X,13HICOLS = ,15,6X,13HJROWS = ,15,6X,13HKPLANS	PUF00920
	1= ,15)	PUF00930
	400 FORMAT(6X,13HNTADV = ,15,6X,13HMAPTIM = ,15,6X,13HTAU	PUF00940
	1= ,15)	PUF00950

600	FORMAT(6X,8HDELX =,F10.2,6X,8HDELY =,F10.2,6X,8HDELZ =,F10.2	PUF00960
1)		PUF00970
700	FORMAT(6X,8HCHEMIN =,E10.4,6X,8HREFLEC =,F10.5,6X,13HTURN =	PUF00980
1)		PUF00990
C	1) SKIPPING LINE PRINTING OF PRIMDATA IF SPECIFIED	PUF01000
	IF(ABC(5) .EQ. NO) GO TO 751	PUF01010
	DO 750 I = 1,5	PUF01020
750	WRITE(6,1)	PUF01030
	WRITE(6,35) TITLE	PUF01040
	WRITE(6,1)	PUF01050
	WRITE(6,1)	PUF01060
	WRITE(6,100)	PUF01070
	WRITE(6,1)	PUF01080
	WRITE(6,200) ITIME,NRELSE,NSTEPS	PUF01090
	WRITE(6,1)	PUF01100
	WRITE(6,300) ICOLS,JROWS,KPLANS	PUF01110
	WRITE(6,1)	PUF01120
	WRITE(6,400) NTADV,MAPTIM,TAU	PUF01130
	WRITE(6,1)	PUF01140
	WRITE(6,600) DELX,DELY,DELZ	PUF01150
	WRITE(6,1)	PUF01160
	WRITE(6,700) CHEMIN,REFLEC,TURN	PUF01170
	WRITE(6,1)	PUF01180
C	751 CONTINUE	PUF01190
C		PUF01200
C	READ SOURCEDATA INPUT FILE	PUF01210
C		PUF01230
	800 FORMAT(A1,I2,A1)	PUF01240
	810 FORMAT(5I5,3F10.5)	PUF01250
	820 FORMAT(48H CURRENT SOURCEDATA : NUMBER OF ACTIVE SOURCES :,I4)	PUF01260
C		PUF01270
C	READ PUFFDATA,TITLESTRING	PUF01280
	READ(4,30) PUFFTX	PUF01290
	WRITE(6,30) PUFFTX	PUF01300
C	READ NUMBER OF MULTISOURCES:NRMULT	PUF01310
	READ(4,800) ABC(3),NRMULT,ABC(4)	PUF01320
	WRITE(6,800) ABC(3),NRMULT,ABC(4)	
C	INPUT FORMAT TESTING:	PUF01330
	IF(ABC(3).NE.AA.OR.ABC(4).NE.AA) GO TO 8920	PUF01340
C	READ INDIVIDUAL SOURCEDATA:	PUF01350
C		PUF01360
C	SETTING FRAMEDATA: (M) SMALL-X, (M) FULL-X, ETC.	PUF01370
	MFY = JROWS	PUF01380
	MSX = 1	PUF01390
	MSY = 1	PUF01400
	MFZ = KPLANS	PUF01410
		PUF01420

	MSZ = 1	PUF01430
	XSB=MSX-1	PUF01440
	XLB=MFY-1	PUF01450
	YSB=MSY-1	PUF01460
C	BOTTOM OF FRAME : YBB = YSB - .9	PUF01470
	YBB = YSB - .9	PUF01480
	ZSB = MSZ - 1	PUF01490
	ZLB = MFZ - 1	PUF01500
	YLB=MFY-1	PUF01510
	YLL=YLB + 0.1	PUF01520
	DO 850 I = 1,NRMULT	PUF01530
	READ(4,810) SOURNR,XSOURC(I),YSOURC(I),STRTRL(I),	PUF01540
	2STOPRL(I),SOURST(I),HEATFX(I),SOHT(I)	PUF01550
	WRITE(6,810) SOURNR,XSOURC(I),YSOURC(I),STRTRL(I),	
	2STOPRL(I),SOURST(I),HEATFX(I),SOHT(I)	
C	TESTING INDIVIDUAL SOURCEDATA:	PUF01560
	IF(I.NE.SOURNR) GO TO 8910	PUF01570
C	OFF GRID TEST FOR SOURCE COORDINATES:	PUF01580
	IF(XSOURC(I).GT.XLB.OR.XSOURC(I).LT.XSB.OR.YSOURC(I).GT.YLB.OR.YSOURC(I).LT.YSB) GO TO 9000	PUF01590
	850 CONTINUE	PUF01600
C		PUF01620
	WRITE(6,2)	PUF01630
	WRITE(6,1)	PUF01640
	WRITE(6,35) PUFFTX	PUF01650
	WRITE(6,1)	PUF01660
	WRITE(6,820) NRMULT	PUF01670
	WRITE(6,1)	PUF01680
C		PUF01690
C	SETTING UP STRING VARIABLES FOR PLOTTING PURPOSES	PUF01700
	DO 911 N = 1,105	PUF01710
	STRING(N)=BL	PUF01720
	VERFRM(N)=BL	PUF01730
	VERPLS(N) = BL	PUF01740
911	HORFRM(N) = BL	PUF01750
	NY1=MFY*10	PUF01760
	DO 916 I = MSX,NY1	PUF01770
	NY2=I+4	PUF01780
	DO 915 NN = 1,NY2	PUF01790
915	HORFRM(NN)= SN4	PUF01800
	HORFRM(I+5) = SN2	PUF01810
	NY3=I+6	PUF01820
	NY4=I+9	PUF01830
	DO 916 NN = NY3,NY4	PUF01840
916	HORFRM(NN)= SN4	PUF01850
	VERFRM(10*MFY + 3) = SN5	PUF01860
	VERPLS(10*MFY + 3) = SN3	PUF01870
C		PUF01880
		PUF01890

C	OUTPRINTING CURRENT SOURCE POSITION(S) IN GRID PICTURE	PUF01920
C	SKIP PLOT OF SOURCE POSITIONS IF SPECIFIED IN 'RIMDA	PUF01930
C	IF(ABC(6) .EQ. 'NO') GO TO 999	PUF01940
C	IF(ICOLS.GT. 10) GO TO 995	PUF01950
	860 FORMAT(1H,49X,33H CURRENT SOURCE DATA AS SPECIFIED,/50X,27H IN SOURCE DATA INPUT FILE:,//)	PUF01970
	865 FORMAT(1H0,50X,'SOURCES ARE REPRESENTED BY:',/55X,'SOURCE NUMBER',/55X,'START TIME (SEC)',/55X,'STOP TIME (SEC)',/55X,'SOURCE STRENGTH',/55X,'BUOYANT HEAT FLUX.'//)	PUF01980
	870 FORMAT(2H0,16H Y COORDINATE OF,25X,32H X COORDINATE OF THE GRID POINTS/2X,16H THE GRID POINTS,18,9110/)	PUF01990
	871 FORMAT(2H0,16H Y COORDINATE OF,25X,32H Z COORDINATE OF THE GRID POINTS/2X,16H THE GRID POINTS,18,9110/)	PUF02000
C	WRITE(6,860)	PUF02010
	WRITE(6,865)	PUF02050
	WRITE(6,870) (I,I=XS,XLB)	PUF02060
C	WRITING DATA INTO GRIDPOINTS:	PUF02070
	910 FORMAT(1H+,111,5X,2H +,105A1)	PUF02080
	912 FORMAT(1H+,19X,105A1)	PUF02090
	913 FORMAT(1H,17X,1H,105A1/1H,17X,1H,105A1)	PUF02100
	914 FORMAT(1H+,17X,1H,105A1)	PUF02110
C	WRITE(6,1)	PUF02120
	WRITE(6,912) HORFRM	PUF02130
	WRITE(6,913) VERFRM,VERFRM	PUF02140
	MAX = JROWS - 1	PUF02150
	NY5 = MAX + 1	PUF02160
	DO 950 NY6 = 1, NY5	PUF02170
	I = NY6 - 1	PUF02190
	MAXMI = MAX - I	PUF02200
	WRITE(6,910) MAXMI, VERPLS	PUF02210
	DO 920 J = 1, NRMULT	PUF02220
	IF(MAX-I .NE. YSOURC(J)) GO TO 920	PUF02230
	CALL ISPACE(XSOURC(J),J)	PUF02240
920	CONTINUE	PUF02250
	WRITE(6,913) VERFRM,VERFRM	PUF02260
C	DO 932 J = 1, NRMULT	PUF02270
	IF(MAX-I .NE. YSOURC(J)) GO TO 932	PUF02280
	WRITE(6,914) VERFRM	PUF02290
	CALL ISPACE(XSOURC(J),STRTRL(J))	PUF02300
932	CONTINUE	PUF02310
	WRITE(6,913) VERFRM,VERFRM	PUF02320
		PUF02330
		PUF02340
		PUF02350
		PUF02360
		PUF02370
		PUF02380
		PUF02390
		PUF02400
		PUF02410

C	DO 934 J = 1,NRMULT	PUF02420
	IF(MAX-I.NE.YSOURC(J)) GO TO 934	PUF02430
	WRITE(6,914) VERFRM	PUF02440
	CALL ISPACE(XSOURC(J),STOPRL(J))	PUF02450
934	CONTINUE	PUF02460
	WRITE(6,913) VERFRM,VERFRM	PUF02470
C	DO 940 J=1,NRMULT	PUF02480
	IF(MAX-I.NE.YSOURC(J)) GO TO 940	PUF02490
	WRITE(6,914) VERFRM	PUF02500
	CALL RSPACE(XSOURC(J),SOURST(J))	PUF02510
940	CONTINUE	PUF02520
	WRITE(6,913) VERFRM,VERFRM	PUF02530
C	DO 930 J=1,NRMULT	PUF02540
	IF(MAX-I.NE.YSOURC(J)) GO TO 930	PUF02550
	WRITE(6,914) VERFRM	PUF02560
	CALL RSPACE(XSOURC(J),HEATFX(J))	PUF02570
930	CONTINUE	PUF02580
	WRITE(6,913) VERFRM,VERFRM	PUF02590
	WRITE(6,913) VERFRM,VERFRM	PUF02600
C	950 CONTINUE	PUF02610
	WRITE(6,1)	PUF02620
	WRITE(6,912) HORFRM	PUF02630
C	GO TO 999	PUF02640
990	FORMAT(53H SOURCE DATA PLOT SUPPRESSED BECAUSE"ICOLS"EXCEEDS 10)	PUF02650
995	WRITE(6,990)	PUF02660
999	CONTINUE	PUF02670
C	DEFINE STABILITY AND INTENSITY CLASSES	PUF02680
C	INPUT FROM INTENSITY - DATA: INTSDA	PUF02690
C	960 FORMAT(14 F5.4)	PUF02700
	965 FORMAT(1H0, 46H IN THE CURRENT RUN, THE STABILITY-CLASSES ARE,/41H	PUF02710
	1 CONNECTED TO INTENSITY DATA AS FOLLOWS:)	PUF02720
	970 FORMAT(1H ,21H STABILITY CLASS NO.: ,13,1315)	PUF02730
	975 FORMAT(1H ,21H INTENSITY DATA : , 14F5.4)	PUF02740
C	READ INTSDA,TITLE-STRING:	PUF02750
C	READ(5,30) INSTX	PUF02760
C	WRITE(6,30) INSTX	PUF02770
C	READ INTSDA, NO. OF INTENSITY-CLASSES: NRINCL	PUF02780
C	READ(5,800) ABC(3),NRINCL,ABC(4)	PUF02790
C	WRITE(6,802) NRINCL	PUF02800
C	INPUT FORMAT TESTING:	PUF02810
		PUF02820
		PUF02830
		PUF02840
		PUF02850
		PUF02860
		PUF02870
		PUF02880
		PUF02890

	802	FORMAT(1X,15)	
		IF(ABC(3).NE.AA.OR.ABC(4).NE.AA) GO TO 8890	PUF02900
C		READ INTENSITY-CLASSES INTO REAL ARRAY: INTENS	PUF02910
		READ(5,960,END=801) (INTENS(I),I=1,NRINCL)	PUF02920
C		WRITE(6,960) (INTENS(I),I=1,NRINCL)	
		OUTPRINTING CURRENT INTENSITY CLASSES:	PUF02930
C			PUF02940
			PUF02950
	801	SKIP PRINTING OF INTENSITY DATA IF SPECIFIED IN PRIMDA	
		IF(ABC(7).EQ.NO) GO TO 980	PUF02970
		WRITE(6,2)	PUF02980
		WRITE(6,35) INTSTX	PUF02990
		WRITE(6,1)	PUF03000
		WRITE(6,965)	PUF03000
		WRITE(6,970) (I,I=1,NRINCL)	PUF03010
		WRITE(6,975) (INTENS(I),I=1,NRINCL)	PUF03020
		WRITE(6,1)	PUF03030
		WRITE(6,1)	PUF03040
		WRITE(6,1)	PUF03050
	980	CONTINUE	PUF03060
		END OF INTENSITY DATA SECTION.	PUF03070
		INPUT FROM STABILITY DATA:STABDA	PUF03080
			PUF03100
			PUF03110
		READ STABDA,TITLESTRING:	PUF03120
		READ(3,30) STABTX	
C		READ STABDA,POTENTIAL TEMPERATURE GRADIENT (>0).	PUF03140
		READ(3,889) DTDZ	PUF03150
C		READ STABDA,LIMIT OF MIXING DEPTH: ZM (METERS).	PUF03160
		READ(3,992) ZM	PUF03170
C		INDATA-TEST ON ZM:	PUF03180
		IF(AMOD(ZM,DELZ).NE.0.)GO TO 8880	
C		OUTPRINTING CURRENT STABILITY-DATA:	PUF03200
	889	FORMAT(F10.4)	PUF03210
	991	FORMAT(1H0,45H IN THE CURRENT RUN,THE POTENTIAL TEMPERATURE/21H	PUF03220
		GRADIENT IS SET TO:,F10.4)	PUF03230
	992	FORMAT(F10.2)	PUF03240
	993	FORMAT(1H0,36H NO FINAL MIXING DEPTH IS SPECIFIED.)	PUF03250
	994	FORMAT(1H0,32H THE MIXING LAYER IS LIMITED AT:,F10.2,8H METERS.)	PUF03260
		WRITE(6,1)	PUF03270
		WRITE(6,1)	PUF03280
		WRITE(6,1)	PUF03290
		WRITE(6,35) STABTX	PUF03300
		WRITE(6,1)	PUF03310
		WRITE(6,1)	PUF03320
		WRITE(6,991) DTDZ	PUF03330
		WRITE(6,1)	PUF03340
			PUF03350

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C      WRITE(6,20)
C      IF(ZM.GV:.GT.:0:) WRITE(6,993)
C      IF(ZM.GV:.GT.:0:) WRITE(6,994) ZM
C
C      END OF STABILITY DATA SECTION.
C
C      INPUT FROM WINDDATA:
1110 FORMAT(16,I,X,16,I,X,16,A1,14,A1)
1120 FORMAT(1,H0,2,M,CURRENT WINDATA: STARTDATE=,16,4X,10HSTARTHOUR=,14,
C      14X,14HWINDAV,(SEC-1)=14)
C      READ(2,30) WINDTX
C      READ(2,30) WINDTNR
C      READ(2,110) DATE,STRTHR,ABC(1),WINDAV,ABC(2)
C      INPUT FORMAT TESTING:
C      IF(ABC(1).NE.AA.OR.ABC(2).NE.AA) GO TO 8990
C      WRITE(6,2)
C      WRITE(6,1)
C      WRITE(6,1)
C      WRITE(6,1)
C      WRITE(6,1)
C      WRITE(6,3) WINDTX
C      WRITE(6,1)
C      WRITE(6,120) DATE,STRTHR,WINDAV
C
C      TESTING ON SPECIFIED TIME INCREMENTS: TAU,NTADV,WINDAV:
C      TEST1 = MOD(TAU,NYADV)
C      IF(TEST1.NE.0) GO TO 8980
C      TEST2 = MOD(WINDAV,NTADV)
C      IF(TEST2.NE.0) GO TO 8970
C      END OF FIXED WINDATA SPECIFICATIONS.
C
C*****
C***** INITIAL SECTION*****
C*****
C
C      (THIS PART OF THE PROGRAM IS ONLY PASSED ONCE.)
C
C      1130 FORMAT(14(A1,A1))
C      COUNTER FOR STABILITY SPECIFICATIONS GIVEN BY WINDATA: NRSTAB
C      NRSTAB = 0
C      INITIATING A THREE DIMENSIONAL GRID: CHI
C      DO 1200 I = 1,ICOLS
C      DO 1200 J = 1,JROWS
C      DO 1200 K = 1,KPLANS
C      1200 CHI(I,J,K) = 0

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[illegible]

C	NUMBER OF PUFF RELEASES PER SEC: TAUINVERS.	PUF03860
	TAUINV = 1.0/ FLOAT(TAU)	PUF03870
C		PUF03880
C	NUMBER OF ADVECTION STEPS PER SEC.: ADSTPS.	PUF03890
C	ADSTPS = 1.0/ FLOAT(NTADV)	PUF03900
C	BASIC DOSE PER PUFF: (GRAM/SEC.)*TAU = GRAM/PJFF.	PUF03910
	BADOPP = 1*TAU	PUF03920
C		PUF03930
C	NUMBER OF BASIC ADVECTION STEPS (INTEGER NUMBER) PER PUFF RELEASE:	PUF03940
	NADPRP = TAU/NTADV	PUF03950
C		PUF03960
C	NUMBER OF BASIC ADVECTION STEPS (INTEGER NUMBER) PER WINDFIELDSP.	PUF03970
	NADPRW= WINDAV/NTADV	PUF03980
C		PUF03990
C		PUF04000
C	TOTAL RUNTIME COUNTER: TOTTIM.	PUF04010
	TOTTIM =0	PUF04020
C		PUF04030
C		PUF04040
C	COUNTER FOR REMOVED PUFFS: LEAVE	PUF04050
	LEAVE = 0	PUF04060
C	STABILITY PARAMETER FOR PLUMERISE:	PUF04070
C	STABPA = G/T*(DTHETE/DZ)	PUF04080
	STABPA = .033*DTDZ	PUF04090
C	CONSTANT IN CONNECTION WITH PLUMERISE FORMULA -OR USE IN	PUF04100
C	SUBROUTINE SIGRIS: CONST1.	PUF04110
	CONST1 = 0.6667 * 1.6**1.5	PUF04120
C		PUF04130
C	IF MIXING DEPTH IS NOT SPECIFIED,SET NOMXDP = .TRUE.	PUF04140
	IF(ZM .EQ. 0.) NOMXDP = .TRUE.	PUF04160
C		PUF04170
C	IF REFLECTANCE AT GROUND LEVEL IS SPECIFIED,SET GRRFLX = .TRUE.	
	IF(REFLEC .GT. 0.) GRRFLX = .TRUE.	PUF04190
C	MIXING DEPTH IN GRID-UNITS: ZMG	
	ZMG = ZM/DELZ	PUF04210
C	TESTING THAT MIXING DEPTH IS INSIDE GRID:	PUF04220
	IF(ZMG .GT. (KPLANS -1)) GO TO 8870	PUF04230
C		PUF04240
C	END OF INITIAL SECTION	PUF04250
C		PUF04260
C		PUF04270
C	*****	PUF04280
C	*****CALCULATION SECTION*****	PUF04290
C	*****	PUF04300
C		PUF04310
C	READING STABILITY CLASS AND WINDDATA FROM INPUTFILE:	PUF04320
	1135 READ (2,1130) (TYPE(I),DATA(I) , I = 1,14)	PUF04330

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BACKSPACE 2
IF (TYPE(1).EQ.ANFO) READ(2,1131)(NBUF(I),SBUF(I),I=1,7)
IF (TYPE(1).EQ.ANFO) WRITE(6,1131)(NBUF(I),SBUF(I),I=1,7)
IF (TYPE(1).EQ.SLASH) READ(2,1130)
1131 FORMAT(7(1X,14,1X,F4,1))
C LOOP THRU WINDDATA AT SPECIFIED TIMESTEPS
I = 1
IF (TYPE(1).NE.SLASH) GO TO 1150
NRSTAB = NRSTAB + 1
C
C COUNTING NUMBER OF WINDDATA SPECIFICATIONS: IWDASP
IWDASP = 0
C READING STABILITY CATEGORY FROM WINDDATA:
CLASS = DATA(1)
IF (CLASS.EQ. A ) POINT = 1
IF (CLASS.EQ. B ) POINT = 2
IF (CLASS.EQ. C ) POINT = 3
IF (CLASS.EQ. D ) POINT = 4
IF (CLASS.EQ. E ) POINT = 5
IF (CLASS.EQ. PUNK) GO TO 8930
IF (CLASS.EQ. BLANK) GO TO 8940
1140 FORMAT(53H PROGRAM STOPPED ORDINARILY FM WINDDATA SPECIFICATION)
WRITE(6,1)
WRITE(6,1141) NRSTAB,POINT
WRITE(6,1)
1141 FORMAT(4H THE,13,38H. STABILITY SPECIFICATION CLASS IS NO.,11)
GO TO 1135
C
C INPUT STRUCTURE TEST:
1150 IF (TYPE(1).NE.ANFO .OR. TYPE(I+1).NE.ASTER) GO TO 1160
C IWDASP = IWDASP + 1
C CURRENT WINDDATA:
JI = (I+1)/2
ANGLE = NBUF(JI)
SPEED = SBUF(JI)
GO TO 1175
1160 IF (TYPE(1).NE.BLANK .OR. TYPE(I+1).NE.BLANK) GO TO 8950
C READ NEW DATA IN LINE 1135
GO TO 1135
C INDATA PART OF PROGRAM TERMINATED.
1175 CONTINUE
C
C CURRENT WINDDATA PRESENT.
C
C OUTPRINTING CURRENT WINDDATA:
C WRITE(6,1161) IWDASP ,ANGLE, SPEED
C

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PUF04350
PUF04360
PUF04370
PUF04380
PUF04390
PUF04400
PUF04410
PUF04420
PUF04430
PUF04440
PUF04450
PUF04460
PUF04470
PUF04480
PUF04490
PUF04500
PUF04530
PUF04540
PUF04550
PUF04560
PUF04570
PUF04580
PUF04590
PUF04600
PUF04610
PUF04620
PUF04630
PUF04640
PUF04650
PUF04660
PUF04670
PUF04680
PUF04690
PUF04700
PUF04710
PUF04720
PUF04730
PUF04740
PUF04750
PUF04760
PUF04770
PUF04780

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C		PUF04790
C	CALCULATING WIND VELOCITY IN GRID UNITS: VGX, VGY	PUF04800
	VGX = SPEED*(COS(ANGLE*3.142/180)) / DELX	PUF04810
	VGY = SPEED*(SIN(ANGLE*3.142/180)) / DELY	PUF04820
C		PUF04830
C	RENAMING WIND AVERAGING TIME: WINDAV AS TAV:	PUF04840
	TAV = WINDAV	PUF04850
	1161 FORMAT(4H THE, I4, 49H WINDDATASET IN THE CURRENT STAB.CLASS IS: ANG	PUF04860
	1LE=, I4, 8H , SPEED=, F4.1)	PUF04870
C		PUF04880
C	LOOP THRU BASIC ADVECTION STEPS WITH CURRENT WIND FIELD	PUF04900
C		
C	DO 5000 NN=1, NADPRW	PUF04920
C		
C	JUMPING OVER "ZERO-SETTING" OF CONCENTRATION MATRIX : CHI , IF	PUF04940
C	"DOSE MODE" IS SPECIFIED IN PRIMDA.	PUF04950
	IF(ABC(8).EQ. DOSE) GO TO 1256	PUF04960
C		PUF04970
	DO 1255 IG=1, ICOLS	PUF04980
	DO 1255 JG=1, JROWS	PUF04990
	DO 1255 KG=1, KPLANS	PUF05000
	1255 CHI(IG, JG, KG) = 0.0	PUF05010
C		PUF05020
C	1256 CONTINUE	PUF05030
C		PUF05040
C	TIMECOUNTER: TOTTIM (SEC.)	PUF05050
	TOTTIM = TOTTIM + NTADV	PUF05060
C	SKIPPING RELEASE-SECTION IF SPECIFIED	
	IF(TOTTIM.GT. NRELSE) GO TO 1250	PUF05080
C	TESTING IF RELEASE CONDITIONS ARE FULFILLED	PUF05090
	IF(MOD(TOTTIM, TAU) .NE. 0) GO TO 1250	PUF05100
C		PUF05110
C	LOOP THRU MULTIPLE SOURCES	PUF05130
	DO 1250 I2 = 1, NRMULT	PUF05140
C		PUF05150
C	INDIVIDUAL RELEASE CONTROL AS SPECIFIED IN SOURCE DATA:	PUF05170
C		PUF05180
	IF((TOTTIM.LT. STRTRL(I2)) .OR. (TOTTIM.GT. STOPRL(I2))) GO TO 1250	PUF05190
C	TOTAL NUMBER RELEASED FROM SOURCE(I2): TPUFFS(I2):	PUF05200
	TPUFFS(I2) = TPUFFS(I2) + 1	PUF05210
C		PUF05220
C	SHIFTING PUFF TABLE ONE POSITION TO THE RIGHT AND THEREBY	PUF05230
C	GIVING SPACE FOR ONE NEW PUFF:	PUF05240
C		PUF05250
	J=1	PUF05260
1204	DO 1205 K=1, 7	PUF05270
1205	SHIFT(J+1, K) = PTABEL(I2, J, K)	PUF05280
	J = J + 1	PUF05290

	IF(J,GE,100) GO TO 8900	PUF05300
	IF(PTABEL(I2,J,1).NE.0) GO TO 1204	PUF05310
	DO 1210 L = 2,J	PUF05320
1209	DO 1210 K = 1,7	PUF05330
1210	PTABEL(I2,L,K) = SHIFT(L,K)	PUF05340
C		PUF05350
	INSERTING NEW PUFF DATA IN PUFF TABLE AT J = 1	PUF05380
C	PTABEL(I2,1,1) = TPUFFS(I2)	PUF05390
C	DOSE RELEASED WITH EACH PUFF: SPECIFIED SOURCE STRENGTH*SEC.	
C	BETWEEN RELEASES	PUF05410
	PTABEL(I2,1,2) = SOURST(I2) * TAU	PUF05420
C		PUF05430
	LOADING IN INITIAL SOURCE POSITIONS	PUF05440
	PTABEL(I2,1,3) = XSOURC(I2)	PUF05450
	PTABEL(I2,1,4) = VSOURC(I2)	PUF05460
C		
C	TO AVOID NUMERICAL PROBLEMS IN ESTIMATING PLUME RISE,	
C	SET SOHT(I2) (SOURCE HEIGHT) .GE. 1 METER.	
	PTABEL(I2,1,5) = SOHT(I2)/DELZ	PUF05500
C	INITIAL SIZE OF PUFFS:	PUF05510
C	SIGMAXY SET TO 1 METER:	PUF05520
	PTABEL(I2,1,6) = 1	PUF05530
C	SIGMAZ SET TO 1 METER:	PUF05540
	PTABEL(I2,1,7) = 1	PUF05550
C	END OF PUFF RELEASE SECTION.	PUF05560
1250	CONTINUE	PUF05570
C		PUF05580
C	ADVECTION OF ALL PUFF CENTERS	
C		PUF05630
C	ADVANCE OF PUFF CENTERS IN GRID UNITS (HORIZONTALLY)	
	DGX = VGX* NTADV	PUF05650
	DGY = VGY* NTADV	PUF05660
C	TOTALLY TRAVELED DISTANCE BY THE PUFFS IN METERS	
C	DURING CURRENT BASIC ADVECTION STEP: DMS	PUF05680
	DMS = SQRT((DGX*DELX)**2 + (DGY*DELY)**2)	PUF05690
C		PUF05700
C	ADVECTION SECTION FOR ALL EXISTING PUFFS:	PUF05720
C	LOOP THRU ALL SOURCES, COUNTING REMOVED PUFFS: LEAVE	PUF05730
	DO 1300 I2 = 1, NRMULT	PUF05740
	J = 1	PUF05750
C	SKIPPING SOURCE I2, IF THE LAST BORN PUFF HAS LEFT GRID	
	IF(PTABEL(I2,1,1).EQ.0) GO TO 1300	PUF05770
1260	PTBL3 = PTABEL(I2,J,3) + DGX	PUF05780
	PTBL4 = PTABEL(I2,J,4) + DGY	PUF05790
C		PUF05800
C		PUF05840
C	CALLING SUBROUTINE "SIGRIS" , THEREBY ADDING DEVIATION INCREMENT	PUF05850
C	AND PLUME RISE INCREMENT TO PUFF TABLE:	PUF05860

C	PTABEL(I2,J,5): Z-POSITION IN GRIDUNITS	PUF05870
C	PTABEL(I2,J,6): SIGMAX IN METERS	PUF05880
C	PTABEL(I2,J,7): SIGMAZ IN METERS	PUF05890
C	CALL SIGRIS(PTABEL(I2,J,5),PTABEL(I2,J,6),PTABEL(I2,J,7))	PUF05900
C	INTRODUCING AN UPPER LIMIT FOR BUOYANCY CONVECTION: ZM	PUF05910
C	IF(.NOT.NOMXDP.AND.PTABEL(I2,J,5).GT.ZMG) PTABEL(I2,J,5) = ZMG	PUF05920
C	Z - POSITIONS IN GRIDUNITS: PTBL5	PUF05940
C	PTBL5 = PTABEL(I2,J,5)	PUF05950
C	TESTING AND REMOVING PUFFS WHICH HAVE LEFT THE GRID:	PUF05980
C	IF(PTBL3.GT.XSB.AND.PTBL3.LT.XLB.AND.PTBL4.GT.YBB.AND.PTBL4.LE.YL	PUF05990
C	1L.AND.PTBL5.LT.ZLB) GO TO 1290	PUF06000
C	REMOVE SECTION	PUF06010
C	LEAVE = LEAVE + 1	PUF06020
C	IF(PTABEL(I2,J+1,1).EQ. 0) GO TO 1265	PUF06030
C	REMOVING PUFF BORN AT SOURCE I2 WHICH IS NOT THE LONGEST LIVING:	PUF06040
C	LEFT JUSTIFICATION OF OLDER PUFFS:	PUF06050
C	JJ = J + 1	PUF06060
C	1269 DO 1270 K = 1,7	PUF06070
C	1270 SHIFT(JJ,K) = PTABEL(I2,JJ,K)	PUF06080
C	JJ = JJ + 1	PUF06090
C	IF(PTABEL(I2,JJ,1).NE. 0) GO TO 1269	PUF06100
C	SHIFT(JJ,1) = 0	PUF06110
C	JMAX = JJ	PUF06120
C	COPY SHIFT BACK INTO PTABEL:	PUF06130
C	NY7=JMAX-1	PUF06140
C	DO 1275 JJ = J,NY7	PUF06150
C	DO 1275 K=1,7	PUF06160
C	1275 PTABEL(I2,JJ,K) = SHIFT(JJ+1,K)	PUF06170
C	RETURNING TO INCREMENTAL PART WITHOUT INCREASE IN J:	PUF06180
C	GO TO 1260	PUF06200
C	REMOVING LONGEST LIVING PUFF FROM SOURCE(I2):	PUF06210
C	1265 PTABEL(I2,J,1) = 0	PUF06220
C	CONTINUING WITH NEXT SOURCE	PUF06230
C	GO TO 1300	PUF06240
C	REPLACING NEW PUFF POSITION IN PUFF TABLE	PUF06250
C	1290 PTABEL(I2,J,3) = PTBL3	PUF06260
C	PTABEL(I2,J,4) = PTBL4	PUF06270
C	CALCULATING GRID CONCENTRATION IN EACH BASIC ADVECTION STEP	PUF06280
C		PUF06290
C		PUF06300
C		PUF06330
C		PUF06340
C		PUF06350
C		PUF06380
C		PUF06390
C		PUF06420

```

C      RENAMING ESSENTIAL PARAMETERS:
C      DOSE IN CURRENT PUFF:
C      Q1 = PTABEL(12,J,2)
C      SIGMA VALUES IN METERS:
C      SIGMXY = PTABEL(12,J,6)
C      SIGMZ = PTABEL(12,J,7)
C
C      CALCULATING MAXIMUM CONCENTRATION IN EACH PUFF CENTER
C      (PUFF-CHI-CENTER) IN DIMENSION: GRAM/M**3 :
C      CONSTANT : (2*PHI)**(3/2)
C      CONST = 15.7496
C
C      PCHCEN = Q1/(CONST*SIGMZ*SIGMXY**2)
C
C      SKIPPING SUMMATION SECTION IF CONCENTRATION IS TOO LOW
C      IF(PCHCEN.LT.CHEMIN) GO TO 1500
C
C      CALCULATING MAXIMUM RADIUS OF INTEREST FOR EACH PUFF:
C      MAXIMUM PUFF RADIUS IN METERS:
C      PFRMXY = SIGMXY * SQRT(-2.*ALOG(CHEMIN/PCHCEN))
C      PFRMZ = PFRMXY*SIGMZ/SIGMXY
C
C      X-DIRECTION:
C      PUFRGX = PFRMXY/DELX
C      Y-DIRECTION:
C      PUFRGY = PFRMXY/DELY
C      Z-DIRECTION:
C      PUFRGZ = PFRMZ/DELZ
C
C      DETERMINING START AND STOP GRID POINTS FOR ACCUMULATION OF
C      THE PUFFS IN QUESTION:
C
C      ISTRTX = PTBL3 - PUFRGX + 1
C      ISTOPX = PTBL3 + PUFRGX
C      ISTRTY = PTBL4 - PUFRGY + 1
C      ISTOPY = PTBL4 + PUFRGY
C      ISTRTZ = PTBL5 - PUFRGZ + 1
C      ISTOPZ = PTBL5 + PUFRGZ
C
C      CONTROL FOR EXCEEDING GRID DIMENSIONS
C
C      IF(ISTRTX.LT.XSB) ISTRTX=XSB
C      IF(ISOPX.GT.XLB) ISTOPX=XLB
C      IF(ISTRTY.LT.YSB) ISTRTY=YSB
C      IF(ISOPY.GT.YLB) ISTOPY=YLB
C      IF(ISTRTZ.LT.ZSB) ISTRTZ=ZSB
C      IF(ISOPZ.GT.ZLB) ISTOPZ=ZLB

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PUF06430
PUF06440
PUF06450
PUF06460
PUF06470
PUF06480
PUF06490
PUF06510
PUF06520
PUF06530
PUF06540
PUF06550
PUF06560
PUF06570
PUF06590
PUF06600
PUF06610
PUF06620
PUF06630
PUF06640
PUF06650
PUF06660
PUF06670
PUF06680
PUF06690
PUF06700
PUF06710
PUF06720
PUF06730
PUF06740
PUF06750
PUF06760
PUF06770
PUF06780
PUF06790
PUF06800
PUF06810
PUF06820
PUF06830
PUF06840
PUF06850
PUF06860
PUF06870
PUF06880
PUF06890
PUF06900
PUF06910

```


C	UPPER LIMIT IN CASE OF SPECIFIED MIXING DEPTH:ZM	PUF06940
	IF(NOT NOMXDP AND, ISTOPZ .GT. ZMG) ISTOPZ = ZMG	PUF06950
	IF(ISTRIZ .GT. ISTOPZ) GO TO 1500	PUF06960
C	CALCULATE CONTRIBUTIONS TO SURROUNDING GRIDPOINTS	PUF06970
C	PRELIMINAR CALCULATIONS:	PUF06990
C	SIGMAS IN GRIDUNITS:	PUF07000
	SIGGX = SIGMXY/DELX	PUF07010
	SIGGY = SIGMXY/DELY	PUF07020
	SIGGZ = SIGMZ /DELZ	PUF07030
C	CALCULATING DENOMINATOR UNDER EXP-SIGN:	PUF07040
	SIGGX2 = (SIGGX**2)*(-2)	PUF07050
	SIGGY2 = (SIGGY**2)*(-2)	PUF07060
	SIGGZ2 = (SIGGZ**2)*(-2)	PUF07070
C	LOOPING THRU ALL GRIDPOINTS OF INTEREST:	PUF07080
C	DO 1500 KG = ISTRIZ,ISTOPZ	PUF07090
	ZG2NEG = (KG-PTBL5)**2	PUF07100
	PCHI1 = PCHCEN * EXP(ZG2NEG/SIGGZ2)	PUF07110
	IF(GRRFLX) PCHI1 = PCHI1 + PCHCEN*REFLEC*EXP((KG+PTBL5)**2/SIGGZ2)	PUF07120
	IF(NOMXDP) GO TO 1295	PUF07130
	IF((PTBL5+PUFRGZ) .LT. ZMG) GO TO 1295	PUF07140
	ZG2MX = (KG+PTBL5-2*ZMG)**2	PUF07150
	PCHI1 = PCHI1 + PCHCEN*EXP(ZG2MX/SIGGZ2)	PUF07160
1295	DO 1500 IG = ISTRIX,ISTOPX	PUF07170
	XG2 = (IG-PTBL3)**2	PUF07180
	DO 1500 JG = ISTRY,ISTOPY	PUF07190
	YG2 = (JG-PTBL4)**2	PUF07200
C	INDIVIDUAL PUFFS CONTRIBUTION : PCHI,GRAM/M**3	PUF07210
C	PCHI = PCHI1 * EXP(XG2/SIGGX2 + YG2/SIGGY2)	PUF07220
C	IF(PCHI .LT. CHEMIN) GO TO 1500	PUF07230
C	ACCUMULATING IN GRIDPOINTS:	PUF07240
	CHI(IG+1,JG+1,KG+1) = CHI(IG+1,JG+1,KG+1) + PCHI	PUF07250
C	1500 CONTINUE	PUF07260
C	END OF CONCENTRATION CALCULATIONS	PUF07270
C	ADVANCE IN PUFF TABLE (J) DURING BASIC ADVECTION STEP	PUF07280
	J = J + 1	PUF07290
		PUF07300
		PUF07310
		PUF07320
		PUF07330
		PUF07340
		PUF07350
		PUF07360
		PUF07370
		PUF07380
		PUF07410
		PUF07440
		PUF07450
		PUF07460

```

C      IF(PTABEL(I2,J,1) .NE. 0) GO TO 1260
1300 CONTINUE
C      END OF ADVECTION SECTION
C
C*****
C*****      OUTPRINT SECTION      *****
C*****
C      SECTION FOR OUTPRINTING PUFF POSITIONS IN GRID.
C
C      SKIPPING PUFF POSITION PLOT IF SPECIFIED:
C      TOTTIM TRUNCATED TO INTEGER NUMBER: ITOTIM.
C      ITOTIM = TOTTIM
C      IF(MOD(ITOTIM,MAPTIM) .NE. 0) GO TO 1600
1301 FORMAT(1H)
1310 FORMAT(1H0,30X,'PLOT OF CURRENT PUFF POSITIONS',I6,
C      &'SEC AFTER START OF RELEASE.')
1320 FORMAT(1H0,30X,'TOTALLY',I6,'PUFFS HAVE BEEN RELEASED AND',I6,
C      &'PUFFS HAVE LEFT THE GRID.')
1325 FORMAT(1H+,24X,105A1)
1326 FORMAT(1H,17X,1H,105A1)
1327 FORMAT(1H,11.5X,2H+,105A1)
1328 FORMAT(1H+,25X,105A1)
C
C      SUMMING UP ALL PUFFS RELEASED: SUMPUP
C      SUMPUP = 0
C      DO 1329 NPUF = 1,NRMULT
1329 SUMPUP = SUMPUP + TPUFFS(NPUF)
C
C      WRITE(6,1301)
C      WRITE(6,1310) ITOTIM
C      WRITE(6,1)
C      WRITE(6,1320) SUMPUP,LEAVE
C      WRITE(6,1)
C      WRITE(6,1)
C
C      IF(ICOLS .GT. 10) GO TO 1595
C      WRITE(6,870) (I2,I2 = XSB,XLB)
C      WRITE(6,1)
C      WRITE(6,912) HORFRM
C      WRITE(6,913) VERFRM,VERFRM
C
C      LOOPING THRU ALL Y-VALUES OF GRID, STARTING UPPERMOST:

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PUF07470
PUF07480
PUF07490
PUF07500
PUF07510
PUF07520
PUF07530
PUF07540
PUF07550
PUF07560
PUF07570
PUF07580
PUF07590
PUF07610
PUF07620
PUF07630
PUF07640
PUF07650
PUF07700
PUF07710
PUF07720
PUF07730
PUF07740
PUF07750
PUF07770
PUF07780
PUF07790
PUF07800
PUF07810
PUF07820
PUF07830
PUF07840
PUF07850
PUF07860
PUF07870
PUF07880
PUF07890
PUF07900
PUF07910
PUF07920
PUF07930
PUF07940
PUF07950

```

C	MAX = JROWS - 1 OUTER LOOP THRU INTEGER Y-VALUES: NY8=MAX+1 DO 1350 NY9=1,NY8 I2=NY9-1 MAXM12 = MAX - I2 WRITE(6,1327) MAXM12 , VERPLS	PUF07960
C	PLOTTING SOURCE POSITIONS K1 = 0 DO 1330 J = 1,NRMULT IF(MAX-I2 .NE. YSOURC(J)) GO TO 1330 NUMBER OF SOURCES IN MAINLINE: K1 K1 = K1 + 1 CALL ISPACE(XSOURC(J),J) SOURCE POSITIONS IN EACH MAINLINE: XINT(K1) XINT(K1) = 10*XSOURC(J)	PUF08000 PUF08010 PUF08020 PUF08030 PUF08040 PUF08050 PUF08060 PUF08070 PUF08080 PUF08090
C	1330 CONTINUE	PUF08110 PUF08120 PUF08130 PUF08140
C	LOOPING 9 LINES DOWN TO NEXT MAINLINE: DO 1345 NY10=1,10 IDEC1=NY10-1 YLINE = 10*(MAX - I2) - IDEC1 + 10 IF(IDEC1 .GE. 1) WRITE(6,1326) VERFRM	PUF08160 PUF08170 PUF08180 PUF08190 PUF08200 PUF08210 PUF08220 PUF08230 PUF08240 PUF08250 PUF08260 PUF08270 PUF08280 PUF08290 PUF08300 PUF08310 PUF08320 PUF08330 PUF08340 PUF08350 PUF08360 PUF08370 PUF08380 PUF08400
C	SCANNING THRU WHOLE PUFF TABLE DO 1340 II = 1,NRMULT J = 0 1335 J = J + 1 IF(PTABEL(II,J,1) .EQ. 0) GO TO 1340 TRUNCATING Y-VALUE OF PUFF TO INTEGER: YINT = PTABEL(II,J,4)*10 + 10.5	PUF08160 PUF08170 PUF08180 PUF08190 PUF08200 PUF08210 PUF08220 PUF08230 PUF08240 PUF08250 PUF08260 PUF08270 PUF08280 PUF08290 PUF08300 PUF08310 PUF08320 PUF08330 PUF08340 PUF08350 PUF08360 PUF08370 PUF08380 PUF08400
C	PRINTING "*" IN GRIDFRAME IF X-POSITION OF PUFF NOT COINCIDE WITH ONE OF THE SOURCE POSITIONS IF((YINT .NE. YLINE) .OR. (IDEC1 .NE. 0)) GO TO 1338 COINCD = .FALSE. C INTEGER VALUE OF PUFFS X-POSITION: XINTPF XINTPF = PTABEL(II,J,3) * 10 + .5 DO 1336 KK = 1,K1 1336 IF(XINTPF .EQ. XINT(KK)) COINCD = .TRUE. IF(COINCD) GO TO 1335 STRING(XINTPF + 1) = SN1 GO TO 1335	PUF08160 PUF08170 PUF08180 PUF08190 PUF08200 PUF08210 PUF08220 PUF08230 PUF08240 PUF08250 PUF08260 PUF08270 PUF08280 PUF08290 PUF08300 PUF08310 PUF08320 PUF08330 PUF08340 PUF08350 PUF08360 PUF08370 PUF08380 PUF08400
C	1338 IF(YINT .NE. YLINE) GO TO 1335 PRINTING PUFF POSITIONS BETWEEN Y-GRID LINES: XINTPF = PTABEL(II,J,3) * 10 + .5	PUF08420

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        STRING(XINTPF + 1) = SN1
        GO TO 1335
C
C 1340 CONTINUE
C      END OF PUFF TABLE LOOP.
C
        WRITE(6,1325) STRING
        DO 1342 NST = 1,105
C 1342 STRING(NST) = BL
C
C 1345 CONTINUE
C
        RESET "SOURCE IN LINE COUNTER" XINT(KK)
        DO 1349 KK=1,10
C 1349 XINT(KK) = -1
C
C 1350 CONTINUE
C      END OF PUFF POSITION PLOT.
        WRITE(6,1)
        WRITE(6,912) HORFRM
C 1400 CONTINUE
C
C      PLOTTING PUFFS IN "Y-Z FRAME"; FOR COMMENTS REFER TO THE EQUI-
C      VALENT "Y-X FRAME" PLOTTING DESCRIBED ABOVE.
C
        WRITE(6,1)
        WRITE(6,1)
        WRITE(6,1)
C 881 FORMAT(1H+,20X,15,10H SOURCE(S))
        WRITE(6,871) (12,12=ZSB,ZLB)
        WRITE(6,1)
C      HRFRM2 : STRING CONTAINING HORIZONTAL GRID FRAME
        DO 1410 N = 1,105
        VRFRM2(N) = BL
        VRPLS2(N) = BL
        PARENT(N) = BL
C 1410 HRFRM2(N) = BL
        NY11=HFZ+10
        DO 1418 IHFZ = MSZ,NY11,10
        NY12=IHFZ+4
        DO 1411 MN = IHFZ,NY12
C 1411 HRFRM2(MN) = SN4
        HRFRM2(IHFZ+5) = SN2
        NY13=IHFZ+6
        NY14=IHFZ+9
        DO 1416 MM=NY13,NY14
C 1416 HRFRM2(MM) = SN4

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PUF08430
PUF08440
PUF08450
PUF08470
PUF08480
PUF08490
PUF08500
PUF08510
PUF08520
PUF08530
PUF08540
PUF08550
PUF08570
PUF08580
PUF08590
PUF08600
PUF08610
PUF08620
PUF08630
PUF08640
PUF08650
PUF08660
PUF08670
PUF08690
PUF08700
PUF08710
PUF08720
PUF08730
PUF08740
PUF08750
PUF08760
PUF08770
PUF08780
PUF08790
PUF08800
PUF08810
PUF08820
PUF08830
PUF08840
PUF08860
PUF08870
PUF08890

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1418 CONTINUE
WRITE(6,912) HRFRMZ
PARENT(10*ZMG + 1) = SN6
VRFRMZ(10*MFZ + 3) = SN5
VRPLSZ(10*MFZ + 3) = SN3
WRITE(6,1326) VRFRMZ
WRITE(6,1326) VRFRMZ
MAX = JROWS-1
DO 1445 NY15=1,JROWS
I2=NY15-1
MAXI2 = MAX - I2
WRITE(6,1327) MAXI2,VRPLSZ
K1=0
DO 1430 J=1,NRMULT
IF(MAX-I2.NE.YSOURC(J)) GO TO 1430
K1 = K1 + 1
C 1430 CONTINUE
WRITE(6,881) K1
IF(K1.GT.0) WRITE(6,881) K1
DO 1445 NY16=1,10
IDEC1=NY16-1
YLINE = 10*(MAX-I2) - IDEC1 + 10
C IF(IDEC1.GE.1) WRITE(6,1326) VRFRMZ
ILLUSTRATING MIXING DEPTH IN Y-Z FRAME:
C IF(ZMG.GT.0) WRITE(6,1328) PARENT
DO 1440 II = 1,NRMULT
J=0
1435 J = J + 1
IF(PTABEL(11,J,1).EQ.0) GO TO 1440
YINT = PTABEL(11,J,4)*10 + 10.5
IF(YINT.NE.YLINE) GO TO 1435
C ZINTPF = PTABEL(11,J,5)* 10 + .5
STRING(ZINTPF + 1) = 'SN1'
GO TO 1435
C 1440 CONTINUE
C WRITE(6,1325) STRING
DO 1442 NST = 1,105
1442 STRING(NST) = BL
C 1445 CONTINUE
C WRITE(6,1)
C WRITE(6,912) HRFRMZ
C SECTION FOR OUTPRINTING GRID CONCENTRATIONS

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```

PUF08900
PUF08910
PUF08920
PUF08930
PUF08940
PUF08950
PUF08960
PUF08970
PUF08980
PUF08990
PUF09000
PUF09010
PUF09020
PUF09030
PUF09040
PUF09050
PUF09060
PUF09080
PUF09090
PUF09110
PUF09120
PUF09130
PUF09140
PUF09150
PUF09160
PUF09170
PUF09180
PUF09190
PUF09200
PUF09210
PUF09220
PUF09230
PUF09240
PUF09250
PUF09260
PUF09270
PUF09280
PUF09290
PUF09300
PUF09310
PUF09320
PUF09330
PUF09350

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C		PUF09360
C	SKIPPING CONCENTRATION PRINTING IF SPECIFIED IN PRIMDA.	
	IF(ABC(9).EQ. NO) GO TO 1600	
C		PUF09380
	1510 FORMAT(1H0,49X,37H PRINT OF CURRENT GRID CONCENTRATIONS,/50X	PUF09390
	1,16,29H SEC. AFTER START OF RELEASE.)	PUF09410
	1520 FORMAT(1H0,49X,32H GRIDCONCENTRATION IN THE PLANE:/51X,3HZ =F6.2	PUF09420
	1,25H METER ABOVE THE SURFACE.)	PUF09430
	1525 FORMAT(111,8X,10E10.2)	PUF09440
C		PUF09450
	WRITE(6,1301)	PUF09460
	WRITE(6,1510) ITOTIM	PUF09470
	WRITE(6,1)	PUF09480
	WRITE(6,1)	PUF09490
C		PUF09500
C	LOOP THRU ALL Z LEVELS	PUF09510
C		PUF09520
	DO 1550 KC=1,KPLANS	PUF09530
	DEMCM1 = DELZ*(KC-1)	PUF09540
	WRITE(6,1520) DEMCM1	PUF09550
	WRITE(6,1)	PUF09560
	WRITE(6,870) (IC,IC = XSB,XLB)	PUF09570
C	PRINTING EACH LINE IN CONCENTRATION TABLE:	PUF09580
	DO 1560 JC = 1,JROWS	PUF09590
	JJC = JROWS - JC	PUF09600
	JC1 = JJC + 1	PUF09610
	WRITE(6,1525) JJC, (CHI(IC,JC1,KC) , IC = MSX,MFX)	PUF09620
	DO 1551 IC=MSX,MFX	PUF09630
	1551 CPLOT(IC,JC1)=CHI(IC,JC1,KC)	PUF09640
	1552 FORMAT(5X,10E10.2)	PUF09650
	1560 CONTINUE	PUF09660
C		PUF09670
C	KC IS THE NO. OF LEVELS PRINTED...HERE CONTROLS WHICH	
C	LEVELS ARE CONTOURED.	
	IF (KC.EQ.1) CALL DRAW(CPLOT,10,17)	
	1550 CONTINUE	PUF09690
	WRITE(6,1)	PUF09710
	WRITE(6,1)	PUF09720
C		PUF09730
	GO TO 1600	PUF09750
C		PUF09760
	1590 FORMAT(95H PUFF POSITION PLOT AND GRID CONCENTRATION PRINTING AR	PUF09770
	1E SUPPRESSED BECAUSE "ICOLS" EXCEED 10.)	PUF09780
	1595 WRITE(6,1590)	PUF09790
C		PUF09800
	1600 CONTINUE	PUF09830
C	END OF GRID CONCENTRATION PRINTING SECTION	PUF09840
C		PUF09870

C	END OF OUTPRINT SECTION.	PUF09880
C		PUF09910
C	5000 CONTINUE	PUF09920
C	END OF ADVECTION STEPS DURING CURRENT WIND FIELD SPECIFICATION	PUF09930
C		PUF09940
C	END OF CALCULATION PART.	PUF09960
	I = I+2	PUF09970
	IF(I.GE.14) GO TO 1135	PUF09980
C	RETURN FETCHING NEW ANGLE,SPEED:	PUF09990
	GO TO 1150	PUF10000
C		PUF10020
C	OUTPUT DIAGNOSTICS :	PUF10030
C	1000 FORMAT(37H X AND/OR Y COORDINATES OF SOURCE NR:,I5,12H IS OFF GRID	PUF10040
	1)	PUF10050
	1005 FORMAT(72H FORMAT ERROR IN SECOND WINDDA CARD:MISSING OR WRONG PL	PUF10060
	1ACED #-CHARACTER))	PUF10070
	1010 FORMAT(55H BAD SPECIFICATION OF PUFF RELEASE AND ADVECTION STEP,	PUF10080
	15H TAU=,I5,6X,7H NTADV=,I5)	PUF10090
	1015 FORMAT(60H BAD SPECIFICATION OF WINDAVERAGING TIME AND ADVECTION S	PUF10100
	1TEP:,8H WINDAV=,I4,7X,7H NTADV=,I5)	PUF10110
	1025 FORMAT(64H ERROR IN WINDATA-SPECIFICATION OF: *SPEED,*ANGLE, AFT	PUF10120
	1ER THE:,I6,24H STABILITY SPECIFICATION)	PUF10130
	1030 FORMAT(86H MISSING STABILITY CLASS SPECIFICATION,THE LAST SPECIFI	PUF10140
	1ED STABILITY CLASS NUMBER WAS,I6)	PUF10150
	1035 FORMAT(72H FORMAT ERROR IN SECOND PUFFDA-CARD: MISSING OR WRONG PL	PUF10160
	1ACED #-CHARACTER))	PUF10170
	1040 FORMAT(16H MISMATCH IN THE,I5,22H. SOURCE SPECIFICATION)	PUF10180
	1045 FORMAT(12H SOURCE NR:,I5,72H HAS MORE THN 100 CONTRIBUTING PUFFS	PUF10190
	1 IN THE GRID.TAU MUST BE INCREASED.)	PUF10200
	1050 FORMAT(72H FORMAT IN SECOND INTSDA-CARD: MISSING OR WRONG PL	PUF10210
	1ACED #-CHARACTER))	PUF10220
	1055 FORMAT(41H ZH MUST BE AN INTEGER MULTIPLUM OF DELZ))	PUF10230
	1060 FORMAT(47H MIXING LAYER DEPTH EXCEEDS Z DIMENSION OF GRID)	
C		PUF10250
C		PUF10260
C		PUF10270
	8870 WRITE(6,1060)	PUF10290
	GO TO 9999	PUF10300
	8880 WRITE(6,1055)	PUF10310
	GO TO 9999	PUF10320
	8890 WRITE(6,1050)	PUF10330
	GO TO 9999	PUF10340
	8900 WRITE(6,1045) I	PUF10350
	GO TO 9999	PUF10360
	8910 WRITE(6,1040) I	PUF10370
	GO TO 9999	PUF10380
	8920 WRITE(6,1035)	PUF10390
	GO TO 9999	PUF10400

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8930 WRITE(6,1140)
GO TO 9999
8940 NRM1 = NRSTAB - 1
WRITE(6,1030) NRM1
GO TO 9999
8950 WRITE(6,1025) NRSTAB
GO TO 9999
8970 WRITE(6,1015) WINDAV,NTADV
GO TO 9999
8980 WRITE(6,1010) TAU,NTADV
GO TO 9999
8990 WRITE(6,1005)
GO TO 9999
9000 WRITE(6,1000) I
C
9999 CONTINUE
CALL EFNAME
STOP
END

```

[illegible]

SUBROUTINE SIGRIS(HGN,SIGXY,SIGZ)

THE SUBROUTINE "SIGRIS" (SIGMA-RISE) CALCULATES THE INCREMENT IN SIGMA-XY AND SIGMA-Z DURING EACH BASIC ADVECTION STEP. FURTHER, THE SUBROUTINE ESTIMATES PLUMETISE ASSOCIATED WITH BOUANCY IN THE EFFLUXES.

FOR Z-COORDINATES OF PUFFS: HEIGHT , GRID UNITS(N) : HGN

```
COMMON HEATFX(25), I2,DMS,POINT,INTENS(14),STABPA,FBUFLX
```

1 UNN CONST 1 DEL 2

INTEGER POINT

REAL INTENS CALCULATING

OFFLINE EXPERIMENTAL FITTING CONSTANT: FITCST

OSIGOS = 22 * INTENS (POINT)

THE

CALCULATING PLUME-RISE INCREMENT:

33

[illegible]

00000-00000-000000000
A0000-00000-000000000
00000-00000-000000000
0000000000000000000
0000000000000000000
0000000000000000000
0000000000000000000

00000000000
00000000000
00000000000
00000000000
00000000000
00000000000


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C      FI : BUOYANT FLUX FROM SOURCE I
C      AFTER BRIGGS:
C      F = 8.9 < M**4/SEC**3> * Q < MWATT >
C      HEATFX(12) UNITS ARE KW
C      FI = 8.9 * 0.001 * HEATFX(12)
C
C      IF(STABPA.LE.0.0) GO TO 2501
C      MAXIMUM PLUME LIFT IN STABLE ATMOSPHERE:HSMAX.
C      HSMAXG = 2.9*(FI/(UNN*STABPA))**(1./3) / DELZ
2501  CONTINUE
C
C      CALCULATING PLUME HEIGHT AFTER FILFILLED ADVECTION STEP
C      HGRID(N+1) : HGNP1
C      HGNP1 = HGN + CONST1*SQRT(FI/HGN)/((DELZ *UNN)**1.5)*DMS
C      IF(STABPA.LE.0.0) GO TO 2510
C      IF(HGNP1.GT.HSMAXG) GO TO 2520
2510  HGN = HGNP1
2520  CONTINUE
      RETURN
      END
C
C
C      SUBROUTINE ISPACE(ITEMFT,INR)
C
C      THE SUBROUTINE "ISPACE" MAKES VARIABLE TABULATING POSSIBLE
C      IN CONNECTION WITH FRAMEPLOTS.
C
C      ITEMFT: NUMBER OF TEN SPACES,THE FIGURE IN QUESTION HAS TO
C              BE MOVED RIGHTMOST.
C
C      INR   : INTEGER NUMBER TO BE PRINTED.
C
10  FORMAT(1H+,19X,16)
20  FORMAT(1H+,29X,16)
30  FORMAT(1H+,39X,16)
40  FORMAT(1H+,49X,16)
50  FORMAT(1H+,59X,16)
60  FORMAT(1H+,69X,16)
70  FORMAT(1H+,79X,16)
80  FORMAT(1H+,89X,16)
90  FORMAT(1H+,99X,16)
100 FORMAT(1H+,109X,16)
C
C      IF(ITEMFT.NE.0) GO TO 1
C      WRITE(6,10) INR

```

```

PUF110930
PUF110940
PUF110950
PUF110960
PUF110970
PUF110980
PUF111010
PUF111020
PUF111030
PUF111040
PUF111050
PUF111060
PUF111070
PUF111080
PUF111090
PUF111100
PUF111110
PUF111120
PUF111130
PUF111140
PUF111150
PUF111160
PUF111170
PUF111180
PUF111190
PUF111200
PUF111210
PUF111230
PUF111240
PUF111250
PUF111260
PUF111270
PUF111280
PUF111290
PUF111300
PUF111310
PUF111320
PUF111330
PUF111340
PUF111350
PUF111360
PUF111370
PUF111380
PUF111390
PUF111400
PUF111410
PUF111420

```

```

RETURN
1 IF(IITENFT.NE.1) GO TO 2
WRITE(6,20) INR
RETURN
2 IF(IITENFT.NE.2) GO TO 3
WRITE(6,30) INR
RETURN
3 IF(IITENFT.NE.3) GO TO 4
WRITE(6,40) INR
RETURN
4 IF(IITENFT.NE.4) GO TO 5
WRITE(6,50) INR
RETURN
5 IF(IITENFT.NE.5) GO TO 6
WRITE(6,60) INR
RETURN
6 IF(IITENFT.NE.6) GO TO 7
WRITE(6,70) INR
RETURN
7 IF(IITENFT.NE.7) GO TO 8
WRITE(6,80) INR
RETURN
8 IF(IITENFT.NE.8) GO TO 9
WRITE(6,90) INR
RETURN
9 IF(IITENFT.NE.9) GO TO 1000
WRITE(6,100) INR
1000 RETURN
END

```

C
C
C
C
C
C
C

SUBROUTINE DRAW (A,M,N)

THIS SUBROUTINE CONVERTS THE GRID CONCENTRATIONS TO LOG VALUES
THEN SMOOTHES AND CONTOURES THE PUFF ARRAY...

DIMENSION A(M,N)

A IS THE ARRAY TO BE SMOOTHED AND CONTOURED
M,N IS THE DIMENSION OF ARRAY A

```

DO 1553 JC=1,N
JJC=N-JC
JC1=JJC+1
DO 1554 IC=1,M
IF(A(IC,JC1).LT.1E-12) A(IC,JC1)=0.0
A(IC,JC1)=A(IC,JC1)+1.E13

```

PUF11430
PUF11440
PUF11450
PUF11460
PUF11470
PUF11480
PUF11490
PUF11500
PUF11510
PUF11520
PUF11530
PUF11540
PUF11550
PUF11560
PUF11570
PUF11580
PUF11590
PUF11600
PUF11610
PUF11620
PUF11630
PUF11640
PUF11650
PUF11660
PUF11670
PUF11680
PUF11690
PUF11700
PUF11710
PUF11720

PUF11740

```

IF(A(IC,JC1).EQ.0.0) GO TO 1554
A(IC,JC1)=ALOG10(A(IC,JC1))
1554 CONTINUE
1553 WRITE(6,1555) (A(IC,JC1),IC=1,M)
1555 FORMAT(5X,10E10.2)
C SMOOTH ARRAY
NM1=M-1
NM1=N-1
DO 200 J=1,N
TEMP=A(I,J)
DO 100 I=2,NM1
TEMP1=A(I,J)
A(I,J)=.20*(TEMP+3.*TEMP1+A(I+1,J))
TEMP=TEMP1
100 CONTINUE
200 CONTINUE
DO 400 I=1,M
TEMP=A(I,1)
DO 300 J=2,NM1
TEMP1=A(I,J)
A(I,J)=.20*(TEMP+3.*TEMP1+A(I,J+1))
TEMP=TEMP1
300 CONTINUE
400 CONTINUE
DO 1559 J=1,17
1559 WRITE(6,1555) (A(I,J),I=1,10)
CALL SET(1,1,31,2,58,0,1,0,1,1)
CALL CONREC(A,10,10,17,0,0,1,-1,-1,0)
CALL TICK4(5,8,5,8)
CALL PERIM(9,0,16,0)
CALL FRAME
RETURN
END

```

C
C
C
C
C
C
C

SUBROUTINE RSPACE(ITENFT,RNR)

THIS SUBROUTINE HAS THE SAME PURPOSE FOR REAL FIGURES, AS
ISPACE HAS FOR INTEGER FIGURES.

RNR : REAL NUMBER TO BE PRINTED.

```

10 FORMAT(1H+,19X,F6.1)
20 FORMAT(1H+,29X,F6.1)
30 FORMAT(1H+,39X,F6.1)
40 FORMAT(1H+,49X,F6.1)

```

PUF11750

PUF11760
PUF11770
PUF11780
PUF11790
PUF11800
PUF11810
PUF11820
PUF11830
PUF11840
PUF11850
PUF11860

```

50 FORMAT(1H+,59X,F6.1)
60 FORMAT(1H+,69X,F6.1)
70 FORMAT(1H+,79X,F6.1)
80 FORMAT(1H+,89X,F6.1)
90 FORMAT(1H+,99X,F6.1)
100 FORMAT(1H+,109X,F6.1)

```

C

```

      IF (ITENFT.NE.0) GO TO 1
      WRITE(6,10) RNR
      RETURN
1     IF (ITENFT.NE.1) GO TO 2
      WRITE(6,20) RNR
      RETURN
2     IF (ITENFT.NE.2) GO TO 3
      WRITE(6,30) RNR
      RETURN
3     IF (ITENFT.NE.3) GO TO 4
      WRITE(6,40) RNR
      RETURN
4     IF (ITENFT.NE.4) GO TO 5
      WRITE(6,50) RNR
      RETURN
5     IF (ITENFT.NE.5) GO TO 6
      WRITE(6,60) RNR
      RETURN
6     IF (ITENFT.NE.6) GO TO 7
      WRITE(6,70) RNR
      RETURN
7     IF (ITENFT.NE.7) GO TO 8
      WRITE(6,80) RNR
      RETURN
8     IF (ITENFT.NE.8) GO TO 9
      WRITE(6,90) RNR
      RETURN
9     IF (ITENFT.NE.9) GO TO 1000
      WRITE(6,10) RNR
1000 RETURN
      END

```

```

PUF111670
PUF111880
PUF111890
PUF111900
PUF111910
PUF111920
PUF111930
PUF111940
PUF111950
PUF111960
PUF111970
PUF111980
PUF111990
PUF120000
PUF120010
PUF120020
PUF120030
PUF120040
PUF120050
PUF120060
PUF120070
PUF120080
PUF120090
PUF121000
PUF121100
PUF121200
PUF121300
PUF121400
PUF121500
PUF121600
PUF121700
PUF121800
PUF121900
PUF122000
PUF122100
PUF122200
PUF122300
PUF122400
PUF122500

```

Risø - M -

<p>Title and author(s)</p> <p>Description of the Risø puff diffusion model</p> <p>Torben Mikkelsen</p>	<p>Date</p> <p>October 1982</p>
	<p>Department or group</p> <p>Physics Dept.</p>
	<p>Group's own registration number(s)</p>
<p>43 pages + tables + illustrations</p>	<p>Copies to</p>
<p>Abstract</p> <p>The Risø National Laboratory, Roskilde, Denmark, atmospheric puff dispersion model is described. This three-dimensional model simulates the release of Gaussian pollutant puffs and predicts their concentration as they are diffused and advected downwind by a horizontally homogeneous, time-dependent wind. Atmospheric characteristics such as turbulence intensity, potential temperature gradient, buoyant heat flux and maximum mixing depth have been considered.</p> <p>Available on request from Risø Library, Risø National Laboratory (Risø Bibliotek), Forsøgsanlæg Risø), DK-4000 Roskilde, Denmark Telephone: (02) 37 12 12, ext. 2262. Telex: 43116</p>	