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PTPLU - A Single Source Gaussian Dispersion Algorithm. Addendum

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ADDENDUM TO PTPLU
A Single Source Gaussian Dispersion Algorithm

by

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16. ABSTRACT

PTPLU has been modified to include urban dispersion coefficients, urban wind profile exponents, and a default option. This modification has resulted in PTPLU - Version 2.0. This document briefly describes the modifications to PTPLU and presents a test case.

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ABSTRACT

PTPLU has been modified to include urban dispersion coefficients, urban wind profile exponents, and a default option. This modification has resulted in PTPLU - Version 2.0. This document briefly describes the modifications to PTPLU and presents a test case.

INTRODUCTION

In 1981, PTPLU (Pierce et al., 1982) was introduced as an improvement over PTMAX (Turner and Busse, 1973). Both models were intended for use as point source screening models in which maximum short-term concentrations were estimated for various meteorological conditions. PTPLU's improvements over PTMAX included wind profile exponents, momentum and buoyancy driven plume rise, and options for calculating buoyancy induced dispersion, stack tip downwash, and gradual plume rise.

This new version of PTPLU, Version 2.0, offers enhancements to the original PTPLU algorithm. In Version 2.0, we offer a choice of either urban or rural dispersion coefficients and wind profile exponents, and an option for selecting default values.

This addendum describes the changes, presents a test case, and shows FORTRAN coding changes that were made in the batch version of PTPLU. Both the interactive and batch versions of PTPLU-2.0 were included in UNAMAP, Version 6, which was released August 1986. Users wishing information on UNAMAP may contact the Environmental Protection Agency through

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CHANGES TO PTPLU

Urban/Rural Option

A new option was added to Version 2.0 to allow the user to select either urban or rural dispersion coefficients and wind profile exponents. The urban dispersion coefficients, known also as the Briggs urban coefficients are described by Gifford (1976). Their formulation for each stability class is given in Table 1.

Urban and rural wind profile exponents were added and are based on recommendations of Irwin (1979). The exponents are used only in the default mode. Their values as a function of stability class are listed in Table 2. The user should note that the wind profile exponents are read from card type two. Unless the default option is turned on, the values specified by the user in card type two will be used to extrapolate the wind speed from the anemometer height up to stack top.

TABLE 1. URBAN DISPERSION COEFFICIENTS USED IN PTPLU-2.0. Distance, x, is in kilometers; s_y and s_z are in meters.

Stability A and B	$\sigma_y = 320x/(1 + 0.4x)^{1/2}$
	$\sigma_z = 240x/(1 + x)^{1/2}$
Stability C	$\sigma_y = 220x/(1 + 0.4x)^{1/2}$
	$\sigma_z = 200x$
Stability D	$\sigma_y = 160x/(1 + 0.4x)^{1/2}$
	$\sigma_z = 140x/(1 + 0.3x)^{1/2}$
Stability E and F	$\sigma_y = 110x/(1 + 0.4x)^{1/2}$
	$\sigma_z = 80x/(1 + 1.5x)^{1/2}$

TABLE 2. WIND PROFILE EXPONENTS USED AS DEFAULT IN PTPLU-2.0.

Stability class	Rural	Urban
A	0.07	0.15
B	0.07	0.15
C	0.10	0.20
D	0.15	0.25
E	0.35	0.30
F	0.55	0.30

Default option

As previously indicated, the user can invoke an option that will in turn cause other options to be automatically specified and default values of wind profile exponents to be used. The default values for the other options will cause PTPLU-2.0 to do the following: not compute gradual plume rise, compute stack tip downwash, and compute buoyancy induced dispersion.

Although the intent of the default option is to provide a convenient way for the user to perform regulatory modeling, the user should always consult with the EPA Regional Meteorologist/Modeling Contact to ensure that the correct option values have been used.

It should be noted that since PTPLU-2.0 does not consider pollutant removal or chemical reactions, this option does not incorporate a decay half life for urban SO_2 concentration that is included in the "regulatory default option" of several other UNAMAP, Version 6, models.

CHANGES IN INPUT DATA

Because new parameters were added to the model, minor changes were necessary in the input data. The only card type affected by this change was card type one. The new format is listed in Table 3.

The user should note that since free format is used, values must be input for every variable even though certain options will not be recognized when the default option is turned on.

TEST CASE

Table 4 contains the input data for the test case. The data are arranged in free format which means that individual values must be separated by either a comma or a space. Results from the test case are presented in Appendix A.

TABLE 3. PTPLU-2.0 DATA INPUT. Only card type one was modified.

CARD TYPE ONE <<< FREE FORMAT >>>

Variable name	Description
IOPT(1)	Gradual plume rise option 0 = do not compute gradual rise (default value) 1 = compute gradual rise
IOPT(2)	Stack tip downwash option 0 = do not compute stack tip downwash 1 = compute stack tip downwash (default value)
IOPT(3)	Buoyancy induced dispersion option 0 = do not compute buoyancy induced dispersion 1 = compute buoyancy induced dispersion (default value)
T	Ambient air temperature (Kelvin)
HL	Mixing height (m)
Z	Receptor height above the ground surface (m)
IDFLT*	Default option 0 = do not use default values 1 = use default values
MUOR*	Dispersion option 1 = use urban dispersion coefficients 2 = use rural dispersion coefficients

* New variables added for PTPLU-2.0.

TABLE 4. INPUT DATA FOR THE PTPLU-2.0 TEST CASE.

```
0,1,1,278.,1500.,2.,0,2
7.,0.07,0.07,0.10,0.15,0.35,0.55
PTPLU EXAMPLE RUN - INPUT BY T. PIERCE  7/9/86
1000.,200.,450.,20.,5.
```

FORTRAN CODING CHANGES

This section lists those FORTRAN coding changes that are necessary for the original version of PTPLU (contained in Pierce et al., 1982) to correspond to PTPLU, Version 2.0. Users who already have UNAMAP, Version 6, do not need to modify their PTPLU program.

MAIN Program

Replace line PLB00010 with

```
C     PTPLU-2.0 (DATED 86196)
```

Insert after line PLB00510

```
C     IDFLT     DEFAULT OPTION        0:NO DEFAULT
C                                     1:DEFAULT
C     MUOR      DISPERSION            1:URBAN (BRIGGS)
C                                     2:RURAL (PG)
```

Replace line PLB01260 with

```
      COMMON /MS/ KST,X,SY,SZ,MUOR
```

Replace line PLB01320 with

```
     &(6,14),AH2(6,14),UZ(6,14),PL(6),WI(6),PLL(6,2)
```

Insert after line PLB01330

```
      DATA PLL/.15,.15,.20,.25,.30,.30,.07,.07,.10,.15,.35,.55/
```

Replace lines PLB01380 through PLB01410 with

```
5432  WRITE('1',21X,'PTPLU-2.0 (DATED 86196)')
```

Replace lines PLB01420 and PLB01430 with

```
C        READ CARD TYPE 1, OPTIONS, TEMP, MX HT, RECEPTOR HT, IDFLT, MUOR
      READ(IRD,*)(IOPT(I),I=1,3),T,HL,Z,IDFLT,MUOR
```

Insert after PLB01500 the following lines

```
      IF (IDFLT.EQ.0) GO TO 18
C
      DO 15 I = 1,6
15    PL(I) = PLL(I,MUOR)
      IOPT(1) = 0
      IOPT(2) = 1
      IOPT(3) = 1
```

Replace line PLB01510 with

```
18    DO 20 K = 1,6
```

Replace line PLB01710 with

```
       WRITE(IWRI,463) IOPT(3),(PL(I),I=4,6),D
       WRITE(IWRI,464) IDFLT,MUOR,Z
```

Replace lines PLB04630 through PLB04650 with

```
463   FORMAT(1X,'IOPT(3) = ',I1,' (BUOY. INDUCED DISP.)',30X,
     &'D:',F4.2,', E:',F4.2,', F:',F4.2,2X,'STACK DIAM. = ',
     &F9.2,' (M)')
464   FORMAT(1X,'IDFLT   =',I2,' (1 = USE DEFAULT, 0 = NOT USE DEFAULT)'
     &/1X,'MUOR    =',I2,'(1 = URBAN, ',
     &' 2 = RURAL)'/'0***RECEPTOR HEIGHT*** =',F9.2,' (M)')
```

<u>SUBROUTINE RCON</u>

Replace line PLB04950 with

```
      COMMON /MS/ KST,X,SY,SZ,MUOR
```

Replace lines PLB05470 and PLB05480 with

```
C        CALL SIG TO OBTAIN VALUES FOR SY AND SZ
      CALL SIG
```

SUBROUTINE PH

Replace line PLB08030 with

```
      COMMON /MS/ KST,X,SY,SZ,MUOR
```

SUBROUTINE PHX

Replace line PLB08770 with

```
      COMMON /MS/ KST,X,SY,SZ,MUOR
```

SUBROUTINE TPMX

Replace line PLB07280 with

```
      COMMON /MS/ KST,X,SY,SZ,MUOR
```

REPLACE SUBROUTINE PSIG WITH SUBROUTINE SIG

```
      SUBROUTINE SIG
C                    SUBROUTINE SIG
C
C        VERTICAL DISPERSION PARAMETER VALUE, SZ DETERMINED BY
C         SZ = A * X ** B WHERE A AND B ARE FUNCTIONS OF BOTH STABILITY
C         AND RANGE OF X.
C        HORIZONTAL DISPERSION PARAMETER VALUE, SY DETERMINED BY
C         LOGARITHMIC INTERPOLATION OF PLUME HALF-ANGLE ACCORDING TO
C         DISTANCE AND CALCULATION OF 1/2.15 TIMES HALF-ARC LENGTH.
      COMMON /MS/ KST,X,SY,SZ,MUOR
      DIMENSION XA(7), XB(2), XD(5), XE(8), XF(9), AA(8), BA(8), AB(3),
     1BB(3), AD(6), BD(6), AE(9), BE(9), AF(10), BF(10)
      DATA XA /.5,.4,.3,.25,.2,.15,.1/
      DATA XB /.4,.2/
      DATA XD /30.,10.,3.,1.,.3/
      DATA XE /40.,20.,10.,4.,2.,1.,.3,.1/
      DATA XF /60.,30.,15.,7.,3.,2.,1.,.7,.2/
      DATA AA /453.85,346.75,258.89,217.41,179.52,170.22,158.08,122.8/
      DATA BA /2.1166,1.7283,1.4094,1.2644,1.1262,1.0932,1.0542,.9447/
      DATA AB /109.30,98.483,90.673/
      DATA BB /1.0971,0.98332,0.93198/
      DATA AD /44.053,36.650,33.504,32.093,32.093,34.459/
      DATA BD /0.51179,0.56589,0.60486,0.64403,0.81066,0.86974/
      DATA AE /47.618,35.420,26.970,24.703,22.534,21.628,21.628,23.331,2
     14.26/
      DATA BE /0.29592,0.37615,0.46713,0.50527,0.57154,0.63077,0.75660,0
     1.81956,0.8366/
      DATA AF /34.219,27.074,22.651,17.836,16.187,14.823,13.953,13.953,1
     14.457,15.209/
      DATA BF /0.21716,0.27436,0.32681,0.41507,0.46490,0.54503,0.63227,0
     1.68465,0.78407,0.81558/
C
      IF (MUOR.EQ.2)  GO TO 9
C
C           MCELROY-POOLER URBAN DISPERSION PARAMETERS FROM ST. LOUIS
C             EXPERIMENT AS PUT IN EQUATION FORM BY BRIGGS.
C              X IS DISTANCE IN KM.
C              KST IS PASQUILL STABILITY CLASS.
C              SY AND SZ ARE IN METERS.
      GO TO(2,2,3,4,5,5), KST
2     SY=320.*X/SQRT(1.+0.4*X)
      SZ=240.*X*SQRT(1.+X)
      GO TO 6
3     SY=220.*X/SQRT(1.+0.4*X)
      SZ=200.*X
```

```
      GO TO 6
4     SY=160.*X/SQRT(1.+0.4*X)
      SZ=140.*X/SQRT(1.+0.3*X)
      GO TO 6
5     SY=110.*X/SQRT(1.+0.4*X)
      SZ=80.*X/SQRT(1.+1.5*X)
6     IF (SZ.GT.5000.) SZ=5000.
      RETURN
C
    9 XY=X
      GO TO (10,40,70,80,110,140), KST
C        STABILITY A
10    TH=(24.167-2.5334*ALOG(XY))/57.2958
      IF (X.GT.3.11) GO TO 170
      DO 20 ID=1,7
      IF (X.GE.XA(ID)) GO TO 30
20    CONTINUE
      ID=8
30    SZ=AA(ID)*X**BA(ID)
      GO TO 190
C        STABILITY B
40    TH=(18.333-1.8096*ALOG(XY))/57.2958
      IF (X.GT.35.) GO TO 170
      DO 50 ID=1,2
      IF (X.GE.XB(ID)) GO TO 60
50    CONTINUE
      ID=3
60    SZ=AB(ID)*X**BB(ID)
      GO TO 180
C        STABILITY C
70    TH=(12.5-1.0857*ALOG(XY))/57.2958
      SZ=61.141*X**0.91465
      GO TO 180
C        STABILITY D
80    TH=(8.3333-0.72382*ALOG(XY))/57.2958
      DO 90 ID=1,5
      IF (X.GE.XD(ID)) GO TO 100
90    CONTINUE
      ID=6
100   SZ=AD(ID)*X**BD(ID)
      GO TO 180
C        STABILITY E
110   TH=(6.25-0.54287*ALOG(XY))/57.2958
      DO 120 ID=1,8
      IF (X.GE.XE(ID)) GO TO 130
120   CONTINUE
      ID=9
130   SZ=AE(ID)*X**BE(ID)
      GO TO 180
```

```
C         STABILITY F                                                   PLB10160
140   TH=(4.1667-0.36191*ALOG(XY))/57.2958                              PLB10170
      DO 150 ID=1,9                                                     PLB10180
      IF (X.GE.XF(ID)) GO TO 160                                        PLB10190
150   CONTINUE                                                          PLB10200
      ID=10                                                             PLB10210
160   SZ=AF(ID)*X**BF(ID)                                               PLB10220
      GO TO 180                                                         PLB10230
170   SZ=5000.                                                          PLB10240
      GO TO 190                                                         PLB10250
180   IF (SZ.GT.5000.) SZ=5000.                                         PLB10260
190   SY=465.116*XY*SIN(TH)/COS(TH)                                     PLB10270
C         465.116 = 1000. (M/KM) / 2.15                                 PLB10280
      RETURN                                                            PLB10290
C                                                                       PLB10300
      END                                                               PLB10310
```

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PTPLU-2.0 (DATED 86196)
AN AIR QUALITY DISPERSION MODEL IN
SECTION 3. NON-GUIDELINE MODELS.
IN UNAMAP (VERSION 6) JUL 86
SOURCE: UNAMAP FILE ON EPA'S UNIVAC AT RTP, NC.

>>>INPUT PARAMETERS<<<

TITLE PTPLU EXAMPLE RUN - INPUT BY T. PIERCE 7/9/86

OPTIONS	***METEOROLOGY***		***SOURCE***	
IF = 1, USE OPTION	AMBIENT AIR TEMPERATURE =	278.00 (K)	EMISSION RATE =	1000.00 (G/SEC)
IF = 0, IGNORE OPTION	MIXING HEIGHT =	1500.00 (M)	STACK HEIGHT =	200.00 (M)
IOPT(1) = 0 (GRAD PLUME RISE)	ANEMOMETER HEIGHT =	7.00 (M)	EXIT TEMP. =	450.00 (K)
IOPT(2) = 1 (STACK DOWNWASH)	WIND PROFILE EXPONENTS =	A: .07, B: .07, C: .10	EXIT VELOCITY =	20.00 (M/SEC)
IOPT(3) = 1 (BUOY. INDUCED DISP.)		D: .15, E: .35, F: .55	STACK DIAM. =	5.00 (M)
IDFLT = 0 (1 = USE DEFAULT, 0 = NOT USE DEFAULT)				
MUOR = 2 (1 = URBAN, 2 = RURAL)				

RECEPTOR HEIGHT = 2.00 (M)

>>>CALCULATED PARAMETERS<<<

VOLUMETRIC FLOW = 392.70 (M**3/SEC) BUOYANCY FLUX PARAMETER = 468.52 (M**4/SEC**3)

PTPLU EXAMPLE RUN - INPUT BY T. PIERCE 7/9/86

	****WINDS CONSTANT WITH HEIGHT****				****STACK TOP WINDS (EXTRAPOLATED FROM 7.0 METERS)****			
STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
1	.50	.0000	.000	3299.5(2)	.63	.0000	.000	2651.2(2)
1	.80	.0000	.000	2137.2(2)	1.01	.0000	.000	1732.0(2)
1	1.00	.0000	.000	1749.7(2)	1.26	4.2626-004	1.693	1425.6(2)
1	1.50	3.9137-004	1.664	1233.2(2)	1.90	3.4502-004	1.582	1017.1(2)
1	2.00	3.3549-004	1.551	974.9(2)	2.53	3.1652-004	1.236	812.8(2)
1	2.50	3.1605-004	1.246	819.9(2)	3.16	3.3070-004	1.115	690.2(2)
1	3.00	3.2733-004	1.137	716.6(2)	3.79	3.3940-004	1.050	608.5(2)

	****WINDS CONSTANT WITH HEIGHT****				****STACK TOP WINDS (EXTRAPOLATED FROM 7.0 METERS)****			
STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
2	.50	.0000	.000	3299.5(2)	.63	.0000	.000	2651.2(2)
2	.80	.0000	.000	2137.2(2)	1.01	.0000	.000	1732.0(2)
2	1.00	.0000	.000	1749.7(2)	1.26	1.7943-004	7.999	1425.6(2)
2	1.50	1.5562-004	7.765	1233.2(2)	1.90	1.3483-004	6.625	1017.1(2)
2	2.00	1.3268-004	6.170	974.9(2)	2.53	1.3700-004	4.632	812.8(2)
2	2.50	1.3650-004	4.678	819.9(2)	3.16	1.4700-004	3.956	690.2(2)
2	3.00	1.4472-004	4.092	716.6(2)	3.79	1.5500-004	3.526	608.5(2)
2	4.00	1.5571-004	3.427	587.4(2)	5.06	1.6120-004	3.006	506.4(2)
2	5.00	1.6102-004	3.025	509.9(2)	6.32	1.6291-004	2.684	445.1(2)

	****WINDS CONSTANT WITH HEIGHT****				****STACK TOP WINDS (EXTRAPOLATED FROM 7.0 METERS)****			
STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
3	2.00	8.2078-005	14.653	974.9(2)	2.80	9.2853-005	10.077	754.2(2)
3	2.50	8.8390-005	11.076	819.9(2)	3.50	1.0128-004	8.522	643.3(2)
3	3.00	9.5617-005	9.543	716.6(2)	4.19	1.0710-004	7.507	569.4(2)
3	4.00	1.0570-004	7.754	587.4(2)	5.59	1.1349-004	6.249	477.1(2)

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
3	5.00	1.1146-004	6.696	509.9(2)	6.99	1.1555-004	5.500	421.7(2)
3	7.00	1.1556-004	5.495	421.4(2)	9.79	1.1345-004	4.647	358.3(2)
3	10.00	1.1311-004	4.602	355.0(2)	13.98	1.0538-004	3.999	310.1(2)
3	12.00	1.0928-004	4.255	329.1(2)	16.78	1.0068-004	3.717	289.3(2)
3	15.00	1.0373-004	3.884	301.6(2)	20.97	9.3312-005	3.434	268.4(2)

	****WINDS CONSTANT WITH HEIGHT****				****STACK TOP WINDS (EXTRAPOLATED FROM 7.0 METERS)****			
STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX. (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
4	.50	.0000	.000	3299.5(2)	.81	.0000	.000	2074.6(2)
4	.60	.0000	.000	2137.2(2)	1.32	9.9990+009	999.999(3)	1371.6(2)
4	1.00	.0000	.000	1749.7(2)	1.65	9.9990+009	999.999(3)	1137.3(2)
4	1.50	9.9990+009	999.999(3)	1233.2(2)	2.46	1.6112-005	92.700	824.9(2)
4	2.00	9.9990+009	999.999(3)	974.9(2)	3.31	2.0008-005	63.530	668.6(2)
4	2.50	1.6235-005	91.669	819.9(2)	4.13	2.4628-005	48.562	574.9(2)
4	3.00	1.9170-005	71.909	716.6(2)	4.96	2.7673-005	39.600	512.4(2)
4	4.00	2.4067-005	50.450	587.4(2)	6.61	3.1917-005	29.999	434.3(2)
4	5.00	2.7801-005	39.262	509.9(2)	8.27	3.3882-005	26.220	387.5(2)
4	7.00	3.2542-005	29.999	421.4(2)	11.57	3.6949-005	20.600	333.9(2)
4	10.00	3.4767-005	22.750	355.0(2)	16.53	3.6511-005	16.400	290.8(2)
4	12.00	3.4927-005	20.121	329.1(2)	19.84	3.3640-005	14.772	273.2(2)
4	15.00	3.4718-005	17.426	301.6(2)	24.80	3.1826-005	13.204	255.5(2)
4	20.00	3.3589-005	14.706	272.5(2)	33.07	2.8586-005	11.699	237.9(2)

	****WINDS CONSTANT WITH HEIGHT****				****STACK TOP WINDS (EXTRAPOLATED FROM 7.0 METERS)****			
STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
5	2.00	3.9085-005	88.940(1)	380.0(2)	6.47	2.2232-005	54.632	321.8(2)
5	2.50	3.5456-005	80.409(1)	367.1(2)	8.08	1.9687-005	50.352	313.0(2)
5	3.00	3.2630-005	74.290	357.3(2)	9.70	1.7767-005	47.220	306.4(2)
5	4.00	2.8441-005	65.882	342.9(2)	12.93	1.5021-005	42.870	296.6(2)
5	5.00	2.5432-005	60.260	332.7(2)	16.16	1.3611-005	39.999	287.1(2)

	****WINDS CONSTANT WITH HEIGHT****				****STACK TOP WINDS (EXTRAPOLATED FROM 7.0 METERS)****			
STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
6	2.00	9.9990+009	999.999(3)	349.4(2)	12.64	9.9990+009	999.999(3)	280.8(2)
6	2.50	9.9990+009	999.999(3)	338.7(2)	15.80	9.9990+009	999.999(3)	272.7(2)
6	3.00	9.9990+009	999.999(3)	330.5(2)	18.96	9.9990+009	999.999(3)	266.1(2)
6	4.00	9.9990+009	999.999(3)	318.6(2)	25.28	9.9990+009	999.999(3)	257.0(2)
6	5.00	9.9990+009	999.999(3)	310.1(2)	31.60	9.9990+009	999.999(3)	250.9(2)

(1) THE DISTANCE TO THE POINT OF MAXIMUM CONCENTRATION IS SO GREAT THAT THE SAME STABILITY IS NOT LIKELY TO PERSIST LONG ENOUGH FOR THE PLUME TO TRAVEL THIS FAR.

(2) THE PLUME IS CALCULATED TO BE AT A HEIGHT WHERE CARE SHOULD BE USED IN INTERPRETING THE COMPUTATION.

(3) NO COMPUTATION WAS ATTEMPTED FOR THIS HEIGHT AS THE POINT OF MAXIMUM CONCENTRATION IS GREATER THAN 100 KILOMETERS FROM THE SOURCE.