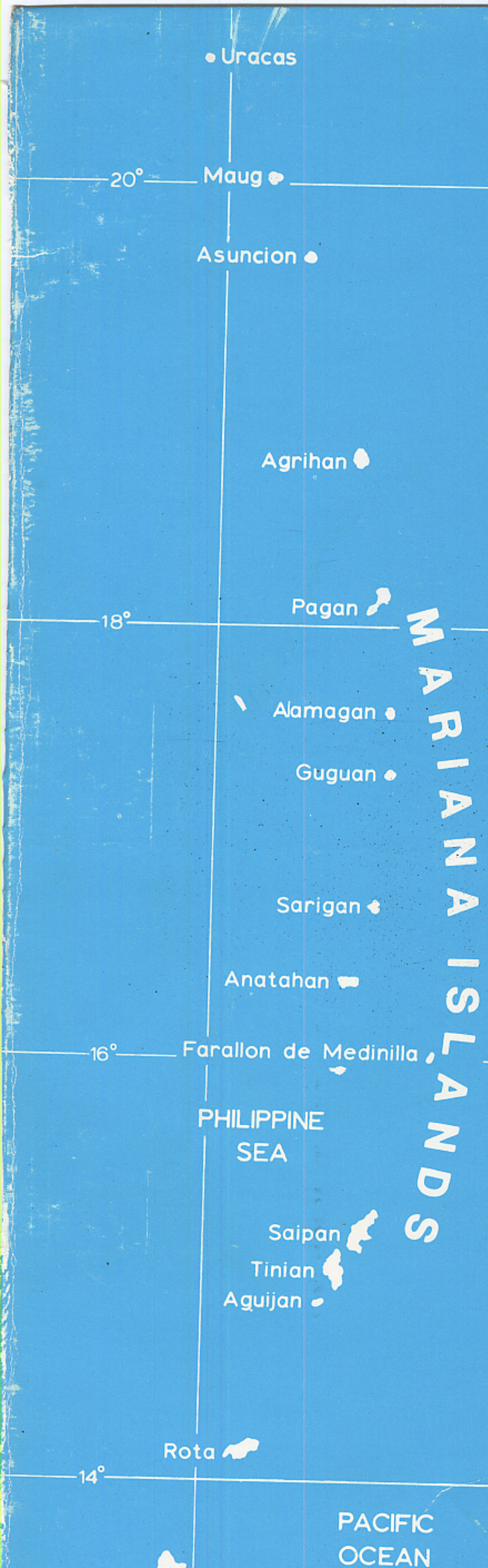

DEVELOPMENT OF A THREE-DIMENSIONAL, STEADY-STATE AIR QUALITY SIMULATION MODEL OVER COMPLEX TERRAIN: VARIATIONAL OPTIMIZATION OF WIND FIELD

By

AKIO WAKE

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INTRODUCTION

The rather excessive public preoccupation of the immediate past with what has been labeled the 'environmental crisis' is now fortunately being replaced by a more sustained and rational concern with pollution problems by public administrators, engineers and scientists. It is to be expected that members of the engineering professions will in the future be called upon to design disposal systems for gaseous and liquid wastes which meet strict pollution control regulations and to advise on possible improvements to existing systems of this kind. The engineering decisions involved will have to be based on reasonably accurate quantitative predictions of the effects of pollutants introduced into the atmosphere, ocean, lakes and rivers. A key input for such predictions comes from the theory of turbulent diffusion, which enables the prediction of the concentrations in which pollutants may be found in the neighborhood of a release duct, such as a chimney or a sewage outfall.

While for the water-related problems there are numerous existing methodologies which are based on rigorous application of the fundamental theory, the approaches presently used for the air-quality problems are yet to be improved. In many cases, rather crude EPA designed pseudo-analytical models are used for administrative judgement of air quality standards. All of the EPA designed air quality models are based on the application of Gaussian plume (or puff) dispersion in an unbounded domain with a variety of statistical and empirical adjustments which are often difficult to justify. These EPA designed models can produce reasonable results in some cases such as the far-field concentration prediction of an unbounded plume in a uni-directional wind. In many cases, however, predicted values are expected to be far from reality because of the excessive empiricism and simplifications in their approach. In such cases, EPA air quality models can only serve as crude guidelines for comparative purposes. One of the great difficulties in carrying out more rigorous air quality modeling approaches is undoubtedly the problem of predicting the three-dimensional wind field over a complex terrain in which pollutants are transported. In theory, it is possible to directly solve the three-dimensional equation of motion for the wind field provided that reliable boundary conditions can be incorporated. In practice, however, such an approach would be a prohibitive undertaking in view of limited computer resources. In this respect, the EPA approaches for air quality modeling are quite understandable.

The present study is an attempt to compromise between the practical applicability and the theoretical conformity in prediction of three-dimensional, steady-state air quality over a complex terrain. The unique feature of the model developed herein is the method of optimizing the 3-D wind field using the variational principle and sparsely measured field data. Since the optimized wind field fully satisfies the continuity requirement, the mass conservation for the subsequent pollutant dispersion computation is guaranteed. This study is, however, not intended to alleviate all the shortcomings of the EPA-type approaches, but rather is an improvement in limited situations. This particular report is fully devoted to the model development stage of a possible continued study and no attempt of calibration and verification with field observation data has yet been made.

MODEL DEVELOPMENT

Method of Variational Optimization for 3-D Wind Field

The basic continuity equation of fluids is given by

$$\frac{\partial \rho}{\partial t} + \vec{\nabla} \cdot (\rho \vec{u}) = 0 \tag{1}$$

where ρ = fluid density

t = time

$\vec{\nabla}\cdot$ = divergence operator

$\vec{u}$ = fluid velocity vector

Assuming the compressibility of the air to be negligible, Equation (1) reduces to

$$\vec{\nabla} \cdot \vec{u} = \frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = 0 \tag{2}$$

where x, y, z = Cartesian coordinate system

u, v, w = x, y, z - components of wind velocity

For a complex terrain, it is convenient for model generality to transform the coordinate system as shown in Figure 1.

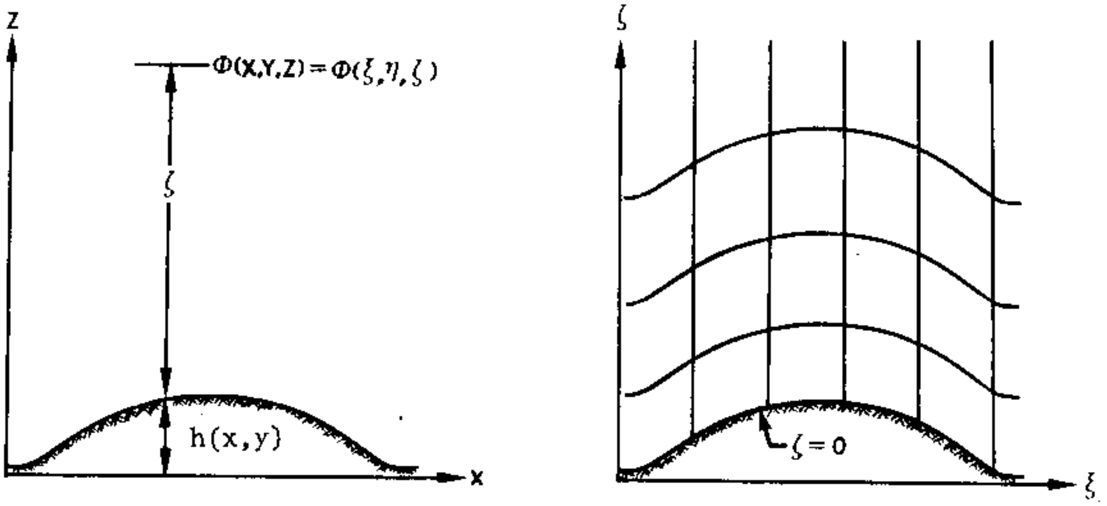

Figure 1. Coordinate Transformation

In the figure,

$$\left.\begin{aligned} x &= \xi \\ y &= \eta \\ z &= \zeta + h(x,y) \end{aligned}\right\} \qquad (3)$$

where (x, y, z) = Cartesian coordinate system

(ξ, η, ζ) = urved coordinate system

h(x, y) = height of the ground surface from any datum.

since $\frac{\partial\xi}{\partial x} = 1$, $\frac{\partial\eta}{\partial y} = 1$, $\frac{\partial\xi}{\partial y} = 0$, $\frac{\partial\eta}{\partial x} = 0$, and $\frac{\partial\zeta}{\partial z} = 1$, it follows that

$$\frac{\partial\zeta}{\partial x} = -\frac{\partial h}{\partial\xi} \qquad (4)$$

$$\frac{\partial\zeta}{\partial y} = -\frac{\partial h}{\partial\eta} \qquad (5)$$

$$\frac{\partial u}{\partial x} = \frac{\partial u}{\partial\xi} - \frac{\partial u}{\partial\zeta}\frac{\partial h}{\partial\xi} \qquad (6)$$

$$\frac{\partial v}{\partial y} = \frac{\partial v}{\partial\eta} - \frac{\partial v}{\partial\zeta}\frac{\partial h}{\partial\eta} \qquad (7)$$

$$\frac{\partial w}{\partial z} = \frac{\partial w}{\partial\zeta} \qquad (8)$$

Summing Equations (6), (7), and (8), we obtain the continuity equation for the transformed coordinate system as

$$\frac{\partial u}{\partial\xi} - \frac{\partial h}{\partial\xi}\frac{\partial u}{\partial\zeta} + \frac{\partial v}{\partial\eta} - \frac{\partial h}{\partial\eta}\frac{\partial v}{\partial\zeta} + \frac{\partial w}{\partial\zeta} = 0 \qquad (9)$$

Equation (9) is the basic condition for the flow-field of an incompressible fluid in which a dissolved or suspended substance must obey the conservation of mass principle.

The approach taken in this model is to enforce this condition [Equation (9)] for the domain of interest while utilizing sparse velocity measurement data to the maximum extent.

Let $\vec{\tilde{v}} = \tilde{u}(\xi, \eta, \zeta)\vec{i} + \tilde{v}(\xi, \eta, \zeta)\vec{j} + \tilde{w}(\xi, \eta, \zeta)\vec{k}$

= estimated wind field based on field measurements.

$\vec{v} = u(\xi, \eta, \zeta)\vec{i} + v(\xi, \eta, \zeta)\vec{j} + w(\xi, \eta, \zeta)\vec{k}$

= computed wind field which satisfy the continuity [Equation (9)].

In order to minimize the square of $(u_i - \tilde{u}_i)$ subject to Equation (9), the present approach utilizes the optimization of a functional, $I(u, v, w, \lambda)$, as

$$I = \iiint [\alpha_i (u_i - \tilde{u}_i)^2] dV + \iiint \lambda \left(\frac{\partial u_i}{\partial \xi_i} - \frac{\partial h}{\partial \xi}\frac{\partial u}{\partial \zeta} - \frac{\partial h}{\partial \eta}\frac{\partial v}{\partial \zeta} \right) dV \tag{10}$$

where α_i = weighting factors;

λ = adjoint function or spatially-variable Lagrangean multiplier;

$dV = d\xi \, d\eta \, d\zeta$;

and the subscript, i, is the standard index notation.

Taking the variation of Equation (10) and applying Green's first identity, we obtain

$$\delta I = \iiint \left\{ [2\alpha_1 (u - \tilde{u}) - \frac{\partial \lambda}{\partial \xi} + \frac{\partial h}{\partial \xi}\frac{\partial \lambda}{\partial \zeta}] \; \delta u \right.$$

$$
\begin{aligned}
&+[2\alpha_2(v-\tilde{v}) - \frac{\partial\lambda}{\partial\eta} + \frac{\partial h}{\partial\eta}\frac{\partial\lambda}{\partial\zeta}]\ \delta v \\
&+[2\alpha_3(w-\tilde{w}) - \frac{\partial\lambda}{\partial\zeta}\ ]\ \delta w \\
&+[\frac{\partial u}{\partial\xi} - \frac{\partial h}{\partial\xi}\frac{\partial u}{\partial\zeta} + \frac{\partial v}{\partial\eta} - \frac{\partial h}{\partial\eta}\frac{\partial v}{\partial\zeta} - \frac{\partial w}{\partial\zeta}]\ \delta\lambda \Big\}\ d\xi\ d\eta\ d\zeta \\
&+\iint \lambda\delta u\Big|_{\xi_B} d\eta\ d\zeta \\
&+\iint \lambda\delta v\Big|_{\eta_B} d\xi\ d\zeta \\
&+\iint (\lambda\delta w - \frac{\partial h}{\partial\xi}\lambda\delta u - \frac{\partial h}{\partial\eta}\lambda\delta v)\Big|_{\zeta_B} d\xi\ d\eta
\end{aligned}
\qquad (11)
$$

in which ξ_B, η_B and ζ_B indicate the boundaries of ξ, η, and ζ, respectively.

Since the variations δu, δv, and δw are arbitrary within the $\xi - \eta - \zeta$ domain, the condition which minimizes $(u_i - \tilde{u}_i)^2$ is $\delta I = 0$. Thus, we obtain the Euler-Lagrange equations for the interior of the domain as:

$$
\left.
\begin{aligned}
u &= \tilde{u} + \tfrac{1}{2}(\frac{\partial\lambda}{\partial\xi} - \frac{\partial h}{\partial\xi}\frac{\partial\lambda}{\partial\zeta}) \\
v &= \tilde{v} + \tfrac{1}{2}(\frac{\partial\lambda}{\partial\eta} - \frac{\partial h}{\partial\eta}\frac{\partial\lambda}{\partial\zeta}) \\
w &= \tilde{w} + \tfrac{1}{2}\frac{\partial\lambda}{\partial\zeta}
\end{aligned}
\right\}
\qquad (12)
$$

At the boundaries, the surface integrals must also vanish; i.e.,

$$
\iint_{\xi} \lambda\delta u d\eta d\zeta = 0 \qquad (13\text{-}a)
$$

$$\iint_{\eta} \lambda \delta v d\xi d\zeta = 0 \tag{13-b}$$

$$\iint_{\zeta} \lambda \left(\delta w - \frac{\partial h}{\partial \xi} \delta u - \frac{\partial h}{\partial \eta} \delta v\right) d\xi d\eta = 0 \tag{13-c}$$

At the open free boundaries, velocities cannot be prescribed. Therefore, we obtain open boundary conditions:

$$\left.\begin{aligned} \lambda\Big|_{\xi_B} &= 0 \\ \lambda\Big|_{\eta_B} &= 0 \\ \lambda\Big|_{\zeta_{uB}} &= 0 \end{aligned}\right\} \tag{14}$$

where $\lambda\Big|_{\zeta_{uB}}$ is the upper boundary surface on the ζ-axis.

At the ground surface, $\zeta = 0$; however, there are five possibilities which satisfy Equation (13-c). They are:

(a) $\lambda = 0$

(b) u, v, and w are prescribed.

(c) $\frac{\partial h}{\partial \xi} = 0$, and w and v are prescribed.

(d) $\frac{\partial h}{\partial \eta} = 0$, and w and u are prescribed.

(e) $\frac{\partial h}{\partial \xi} = \frac{\partial h}{\partial \eta} = 0$, and w is prescribed.

Since $\frac{\partial h}{\partial \xi} \neq 0$, $\frac{\partial h}{\partial \eta} \neq 0$, and δu, δv, and δw are not arbitrary at the ground surface, only (b) can serve as the boundary condition on the ground surface.

For a viscous fluid, u = v = w = 0 on a solid surface. Substituting this condition into Equation (12), we finally obtain the ground surface boundary condition for λ as,

$$\left.\begin{aligned} \left.\frac{\partial\lambda}{\partial\xi}\right|_{\zeta=0} &= 0 \\ \left.\frac{\partial\lambda}{\partial\eta}\right|_{\zeta=0} &= 0 \\ \left.\frac{\partial\lambda}{\partial\zeta}\right|_{\zeta=0} &= 0 \end{aligned}\right\} \qquad (15)$$

Substituting the Euler-Langrange equations [Equation (12)] into the continuity equation [Equation (9)], we obtain the field equation for λ as,

$$\begin{aligned} &\frac{\partial^2\lambda}{\partial\xi^2} + \frac{\partial^2\lambda}{\partial\eta^2} + \left\{1 + \left(\frac{\partial h}{\partial\xi}\right)^2 + \left(\frac{\partial h}{\partial\eta}\right)^2\right\} \frac{\partial^2\lambda}{\partial\zeta^2} \\ &-2\left(\frac{\partial h}{\partial\xi}\frac{\partial^2\lambda}{\partial\xi\partial\zeta} + \frac{\partial h}{\partial\eta}\frac{\partial^2\lambda}{\partial\eta\partial\zeta}\right) - \left(\frac{\partial^2 h}{\partial\xi^2} + \frac{\partial^2 h}{\partial\eta^2}\right)\frac{\partial\lambda}{\partial\zeta} \\ &=2\left(\frac{\partial\tilde{u}}{\partial\xi} - \frac{\partial h}{\partial\xi}\frac{\partial\tilde{u}}{\partial\zeta} + \frac{\partial\tilde{v}}{\partial\eta} - \frac{\partial h}{\partial\eta}\frac{\partial\tilde{v}}{\partial\zeta} + \frac{\partial\tilde{w}}{\partial\zeta}\right) \end{aligned} \qquad (16)$$

By solving Equation (16) for λ subject to the boundary conditions [Equations (14) and (15)] and substituting into the Euler-Langrange equations [Equations (12)], we can obtain the optimized three-dimensional wind field which fully satisfies the continuity requirement.

Initial Estimate of Wind Field Using Sparse Measurement Data

Prior to the optimization described above, an initial estimate of the three-dimensional wind field must be constructed utilizing limited field measurement data. In the present model, two optional interpolation schemes are considered. Scheme 1 is a simple direct distance-based non-linear (exponential in this case) interpolation, i.e.,

$$\left.\begin{aligned} \tilde{u}_i &= \frac{\sum_{j=1}^{n} \Omega_j \ \hat{u}_j}{\sum_{j=1}^{n} \Omega_j} \\ \\ \Omega_j &= \exp(-ar_j) \end{aligned}\right\} \tag{17}$$

in which $\tilde{u}_i = \tilde{u}, \tilde{v}, \tilde{w}$ = estimated wind components at a particular location;

$\hat{u}_j = \hat{u}, \hat{v}, \hat{w}$ = actual measured wind components at location j (j = 1, 2, ····n);

r_i = distance between a particular location where wind components are to be estimated and the location of the measurement station;

a = weighting factor.

Although this scheme is simple and could provide a reasonable estimate for relatively flat ground surfaces, it becomes increasingly difficult to justify as the variation in ground level becomes significant; this approach cannot take into account the boundary layer wind profile near the ground. Furthermore, field measurement of the w-component of local winds is prohibitively difficult in practice.

The second scheme is intended to improve the deficiency of Scheme 1 by taking into account the boundary layer wind profile. For most meteorological purposes, the vertical wind profile is adequately expressed by the power-law (Johnson, 1959; Geiger, 1965):

$$\frac{\bar{v}}{\bar{v}_1} = \left(\frac{z}{z_1}\right)^k \qquad (18)$$

where $\bar{v}$ is the mean wind speed at some height z, and $\bar{v}_1$ is the measured wind speed at some standard height, z_1. The exponent, k, varies with surface roughness and atmospheric stability and usually ranges from 0.1 to 0.6. A detailed analysis of the exponent, k, can be found, for example, in DeMarrais (1959).

In Scheme 2, the vertical profile of horizontal components ($\hat{u}$ and $\hat{v}$) is estimated using the power-law and measurement data at each station. These vertical profiles (at $j = 1, 2 \cdots n$ stations) are then interpolated horizontally for each node point of the entire grid system. The interpolation method used for this scheme is:

$$\vec{V}_\zeta(\xi,\eta) = \sum_{j=1}^{n} w_j(\xi,\eta)\vec{V}_{\zeta sj} \qquad (19)$$

where $w_j(\xi,\eta)$ is a dimensionless weighting function and $\vec{V}_{\zeta sj}$ is the horizontal component of local wind at a particular height for each measurement station. As with Scheme 1, the weighting function $w_j(\xi,\eta)$ is based on the assumption that the influence of each station at a given position is inversely proportional to some power of the distances between the position and the measurement stations.

The weighting function is, therefore, expressed by:

$$w_j(\xi,\eta) = r_j^{-\beta} \Big/ \sum_{j=1}^{n} r_j^{-\beta} \tag{20}$$

where r_j is the horizontal distance between position (ξ,η) and station j. The exponent is chosen here as $\beta = 2.0$, the same value successfully used by Platzman (1963) for the Great Lakes region.

Thus, Scheme 2 can retain the boundary layer profile in the entire domain of interest for the initial estimate. Scheme 2 does not attempt to estimate the vertical component of wind and assumes initially that $\hat{w}(\xi,\eta,\zeta) = 0$ everywhere. The subsequent optimization, however, will enforce the continuity and compute the w-component for each node.

A more physically plausible estimate of vertical wind profile would be the use of the turbulent boundary layer equation (Sutton, 1953):

$$\frac{\bar{u}}{u_*} = \frac{1}{\kappa} \ln \left(\frac{z + z_0}{z_0} \right) \tag{21}$$

in which $\bar{u}$ is the mean horizontal component of wind at elevation z above the ground, u_* is the friction velocity, κ is the von Karman constant, and z_0 is the roughness parameter of the ground surface. Although this approach is not included as an option in the present stage, it could be readily included in the future.

Three-Dimensional Convective Dispersion

For a Cartesian coordinate system, the steady-state convective dispersion equation is given by

$$u\frac{\partial c}{\partial x} + v\frac{\partial c}{\partial y} + w\frac{\partial c}{\partial z} - \frac{\partial}{\partial x}\left(D_x\frac{\partial c}{\partial x}\right) - \frac{\partial}{\partial y}\left(D_y\frac{\partial c}{\partial y}\right) - \frac{\partial}{\partial z}\left(D_z\frac{\partial c}{\partial z}\right) = Q \qquad (22)$$

where c = the mass concentration;

$$\left.\begin{aligned} D_x &= D_x(x,\ y,\ z) \\ D_y &= D_y(x,\ y,\ z) \\ D_z &= D_z(x,\ y,\ z) \end{aligned}\right\} \text{x, y, and z-component of local diffusivity;}$$

$Q = Q(x,\ y,\ z)$ = local source/sink (mass/time).

Although it is not strictly correct, the conventions for air quality analysis express the concentration in terms of volume ratio. Then, c becomes a dimensionless volume ratio (such as ppm) and Q must have the dimensions of volume/volume/time. The boundary condition for Equation (22) is either:

c specified,

or $u_n c - D_n \frac{\partial c}{\partial n}$ specified.

In order to be compatible with the optimized wind field for the (ξ,η,ζ) coordinate system, Equation (22) must also be transformed. After a lengthy operation, the convective-dispersion equation for the (ξ,η,ζ) system becomes:

$$u\frac{\partial c}{\partial \xi} - u\frac{\partial c}{\partial \zeta}\,\frac{\partial h}{\partial \xi} + v\frac{\partial c}{\partial \eta} - v\frac{\partial c}{\partial \zeta}\,\frac{\partial h}{\partial \eta} + w\frac{\partial c}{\partial \zeta}$$

$$-\left(\frac{\partial D_\xi}{\partial \xi} - \frac{\partial h}{\partial \xi}\,\frac{\partial D_\xi}{\partial \zeta}\right)\frac{\partial c}{\partial \xi} - \left[\left(\frac{\partial h}{\partial \xi}\right)^2\frac{\partial D_\xi}{\partial \zeta} - \frac{\partial h}{\partial \xi}\,\frac{\partial D_\xi}{\partial \xi} - D_\xi\frac{\partial^2 h}{\partial \xi^2}\right]\frac{\partial c}{\partial \zeta}$$

$$-D_\xi\frac{\partial^2 c}{\partial \xi^2} + 2D_\xi\frac{\partial h}{\partial \xi}\,\frac{\partial^2 c}{\partial \xi\partial \zeta} - D_\xi\left(\frac{\partial h}{\partial \xi}\right)^2\frac{\partial^2 c}{\partial \zeta^2}$$

$$-\left(\frac{\partial D_\eta}{\partial \eta} - \frac{\partial h}{\partial \eta}\,\frac{\partial D_\eta}{\partial \zeta}\right)\frac{\partial c}{\partial \eta} - \left[\left(\frac{\partial h}{\partial \eta}\right)^2\frac{\partial D_\eta}{\partial \zeta} - \frac{\partial h}{\partial \eta}\,\frac{\partial D_\eta}{\partial \eta} - D_\eta\frac{\partial^2 h}{\partial \eta^2}\right]\frac{\partial c}{\partial \zeta}$$

$$-D_\eta \frac{\partial^2 c}{\partial \eta^2} + 2D_\eta \frac{\partial h}{\partial \eta} \frac{\partial^2 c}{\partial \eta \partial \zeta} - D_\eta \left(\frac{\partial h}{\partial \eta}\right)^2 \frac{\partial^2 c}{\partial \zeta^2}$$

$$-\frac{\partial D_\zeta}{\partial \zeta} \frac{\partial c}{\partial \zeta} - D_\zeta \frac{\partial^2 c}{\partial \zeta^2} = Q \qquad (23)$$

where $u = u(\xi,\eta,\zeta)$;

$v = v(\xi,\eta,\zeta)$;

$w = w(\xi,\eta,\zeta)$;

$h = h(\xi,\eta)$;

$D_\xi = D_\xi(\xi,\eta,\zeta)$;

$D_\eta = D_\eta(\xi,\eta,\zeta)$;

$D_\zeta = D_\zeta(\xi,\eta,\zeta)$;

$c = c(\xi,\eta,\zeta)$;

$Q = Q(\xi,\eta,\zeta)$.

The boundary condition for Equation (23) is either:

c specified

or flux specified.

Therefore, for the ground surface where $\zeta = 0$,

$$\left.\frac{\partial c}{\partial \zeta}\right|_{\zeta=0} = 0 \qquad (24)$$

and for the other five open boundaries, at $\xi=0$, $\xi=\xi_{max}$, $\eta=0$, $\eta=\eta_{max}$, and $\zeta=\zeta_{max}$, the boundary condition is dependent upon the local wind direction.

For inflow boundaries, the flux must be known. Thus,

$$c = c_{background} \qquad (25)$$

For outflow boundaries, the efflux is closely approximated as

$$\left.\begin{array}{ll}\left.\dfrac{\partial c}{\partial \zeta}\right|_{\zeta=\zeta_{max}} & = \text{constant} \\[2ex] \left[\dfrac{\partial c}{\partial \xi} - \dfrac{\partial c}{\partial \zeta}\dfrac{\partial h}{\partial \xi}\right]_{\xi=0,\ \xi=\xi_{max}} & = \text{constant} \\[2ex] \left[\dfrac{\partial c}{\partial \eta} - \dfrac{\partial c}{\partial \zeta}\dfrac{\partial h}{\partial \eta}\right]_{\eta=0,\ \eta=\eta_{max}} & = \text{constant}\end{array}\right\} \qquad (26)$$

Numerical Method of Solution

Equations (12), (16) and (23) with the appropriate boundary conditions comprise the basis for the present modeling effort. The three-dimensionality and the complexity of transformed equations necessitate the use of a simple numerical technique which requires a minimum amount of storage allocation. In the present numerical scheme, the governing equations are discretized in the finite difference form using non-uniform grid spacing. The non-uniform grid system increases programming complexity and execution time considerably as compared with the uniform system ($\Delta\xi$ = constant, $\Delta\eta$ = constant, and $\Delta\zeta$ = constant). In view of versatility in model application, however, such shortcomings could be justified. For both Equations (16) and (23), the iterative method of Liebmann has been employed for its least memory requirement. For the solution of λ [Equation (16)], the Liebmann method has been extrapolated (successive over relaxation by points) for faster convergence. For the solution of c [Equation (23)], the method has been unextrapolated (Gauss-Seidel iteration) for ensured stable convergence.

In the concentration computation, the evaluation of c on the ground surface imposes some difficulties associated with the enforcement of the no-slip condition. In the present numerical scheme, the ground level concentrations are evaluated at a somewhat raised location, i.e., one-fourth of the first vertical mesh distance [¼ of zz(1)].

A user's manual and solution strategies are given at the head of the program listing in Appendix A. An example input and the corresponding output are given in Appendix B and in Appendix C.

Numerical Stability

Since Equation (16) is essentially a Poisson equation, it imposes no critical stability problem. However, as with any convective transport equation, Equation (23) is not always numerically stable. For a linear one-dimensional steady-state convective-dispersion equation, it has been shown (see, for example, Roache, 1972) that the cell Reynolds number condition (or sometimes called the Peclet condition) must be satisfied to ensure numerical stability of the centered difference scheme, i.e.,

$$R_c = \frac{u\Delta x}{\alpha} \leq 2 \qquad (27)$$

where R_c is the cell Reynolds number, u is the constant transport velocity, Δx is the characteristic distance equal to the node spacing, and α corresponds to the diffusivity in the x-direction. Equation (27) is a necessary and sufficient condition only for the constant velocity, one-dimensional centered finite difference for an infinite domain. Although the effects of multi-dimensionality, space-varying velocity, non-uniform grid spacing, and enforcement of particular boundary conditions cannot be ascertained by Equation (27), it can generally serve as a reliable guideline.

In the present model development, this condition is approximately enforced at each node point in all directions and local diffusivities are adjusted accordingly. It should be noted, therefore, that diffusivities actually used in the computation may differ considerably from the values assigned initially depending on local wind and grid spacing. Generally, the longer the distance between the nodes, the greater the value of diffusivity is required for a given wind speed.

For the optimum use of the variable grid spacing system, a fine horizontal mesh should be used near emission sources, preferably near the center of domain. In the vertical direction, numerical stability is not a serious problem since the w-component of wind is generally small. Aside from the numerical stability, determination of local diffusivity should be based on a careful consideration of wind speed, roughness of ground surface, and atmospheric stability. In general, the vertical eddy diffusivity increases linearly upwards from the ground surface within the boundary layer.

ACKNOWLEDGEMENT

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APPENDIX A

SOURCE PROGRAM LISTING

```
* $$ JOB JNM=VOWAQS,CLASS=0,DISP=D,PRI=6,USER='WERIUOG'
* $$ LST CLASS=A,DISP=D,REMOTE=002,COPY=1,RBS=100
// JOB VOWAQS
// OPTION NOLIST,NOLISTX,CATAL
// EXEC PROC=USRCL2
 PHASE VOWAQS,*
// EXEC FFORTRAN
```

IBM JCL

```
C
C******************************** MODEL VOWAQS ***************************
C   *                                                                     *
C   *  A THREE DIMENTIONAL VARIATIONALLY-OPTIMIZED WIND FIELD AND AIR     *
C   *  QUALITY SIMULATION MODEL  FOR  ARBITRARY GROUND TOPOGRAPHY AND     *
C   *  NON-UNIFORM GRID SPACING ... COPYRIGHT BY AKIO WAKE,  APR.1982.    *
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C   *  FORM OR BY ANY MEANS, ELECTRIC, MECHANICAL, PHOTOCOPYING,          *
C   *  RECORDING, OR OTHERWISE, WITHOUT THE PRIOR WRITTEN PERMISSION      *
C   *  OF THE AUTHOR.                                                     *
C   *                                                                     *
C*************************************************************************
C
C------------------------- ARRAY SIZE INFORMATION ------------------------
C
C ---- THIS PROGRAM EMPLOYS THE AUTOMATIC ARRAY TRANSFER SCHEME FOR
C ---- SUBROUTINES.  IF NECESSARY, ADJUST THE DIMENSION SIZES IN MAIN
C ---- PROGRAM ONLY.  SUBROUTINES CAN REMAIN UNALTERED.
C
C ------------------ U(IMAX,JMAX,KMAX)
C ------------------ V(IMAX,JMAX,KMAX)
C ------------------ W(IMAX,JMAX,KMAX)
C ------------------ AC(IMAX,JMAX,KMAX)
C ------------------ AKX(IMAX,JMAX,KMAX)
C ------------------ AKY(IMAX,JMAX,KMAX)
C ------------------ AKZ(IMAX,JMAX,KMAX)
C ------------------ Q(IMAX,JMAX,KMAX)
C ------------------ H(IMAX,JMAX)
C ------------------ XX(IMAX-1)
C ------------------ YY(JMAX-1)
C ------------------ ZZ(KMAX-1)
C ------------------ UM(NM)
C ------------------ VM(NM)
C ------------------ WM(NM)
C ------------------ XM(NM)
C ------------------ YM(NM)
C ------------------ ZM(NM)
C ------------------ IS(MC)
C ------------------ JS(MC)
C ------------------ KS(MC)
C ------------------ SC(MC)
C ------------------ IJKP( MAX0(IMAX,JMAX,KMAX) - 1 )
C ------------------ RDIS(NM)
C ------------------ UP(NM,KMAX)
C ------------------ VP(NM,KMAX)
C ------------------ ZK(KMAX)
C ------------------ IH( MAX0(IMAX,JMAX) )
C ------------------ IV( MAX0(IMAX,JMAX) )
C ------------------ KUI(IMAX*JMAX)
C ------------------ KUJ(IMAX*JMAX)
C ------------------ ILEFTJ(JMAX*(KMAX-1))
C ------------------ ILEFTK(JMAX*(KMAX-1))
C ------------------ IRITEJ(JMAX*(KMAX-1))
```

```
C ----------------- IRITEK(JMAX*(KMAX-1))
C ----------------- JFRNTI(IMAX*(KMAX-1))
C ----------------- JFRNTK(IMAX*(KMAX-1))
C ----------------- JBACKI(IMAX*(KMAX-1))
C ----------------- JBACKK(IMAX*(KMAX-1))
C ----------------- HXLFT(JMAX*(KMAX-1))
C ----------------- HXRHT(JMAX*(KMAX-1))
C ----------------- HYFRT(IMAX*(KMAX-1))
C ----------------- HYBAK(IMAX*(KMAX-1))
C ----------------- ZZLFT(JMAX*(KMAX-1))
C ----------------- ZZRHT(JMAX*(KMAX-1))
C ----------------- ZZFRT(IMAX*(KMAX-1))
C ----------------- ZZBAK(IMAX*(KMAX-1))
C
C ----- DEFINITIONS OF IMAX, JMAX, KMAX, NM, AND [illegible] ARE GIVEN BELOW.
C
C.......................... INPUT INFORMATION .........................
C
C .... TITLE : ANY TITLE HEADING UP TO 80 CHARACTERS
C
C .... II : INPUT DEVICE NUMBER
C .... IO : OUTPUT DEVICE NUMBER
C .... IOT : TAPE(OR DISK) OUTPUT DEVICE NUMBER
C ....      : ( USED ONLY WHEN "TDUMP" = 'YES ' )
C **** I/O UNIT NUMBERS MUST BE DEFINED IN THE MAIN PROGRAM.
C
C .... TDUMP : 'YES ' OR 'NO  ' FOR TAPE(OR DISK) OUTPUT FOR PLOTTING
C .... COMPC : 'YES ' OR 'NO  ' FOR POLLUTANT CONC. COMPUTATION
C ....         : (IF 'NO  ' IS SPECIFIED ONLY THE WIND-FIELD IS COMPUTED.)
C
C .... PECHO  : 'YES ' OR 'NO  ' FOR ECHO-PRINTING OF INPUT DATA
C .... PINTER : 'YES ' OR 'NO  ' FOR PRINTING INTERPOLATED WIND FIELD
C .... PLAMBD : 'YES ' OR 'NO  ' FOR PRINTING LAGRANGEAN MULTIPLYERS
C .... PUVW   : 'YES ' OR 'NO  ' FOR PRINTING OPTIMIZED WIND FIELD
C .... PCONC  : 'YES ' OR 'NO  ' FOR PRINTING CONCENTRATION FIELD
C ....        : (PCONC = 'YES ' IS OVERRIDDEN BY COMPC = 'NO  ' .)
C .... PLT    : 'YES ' OR 'NO  ' FOR HORIZONTAL CONC. PROFILE PLOT
C ....        : (PLT = 'YES ' IS OVERRIDDEN BY COMPC = 'NO  ' .)
C
C .... IMAX : NUMBER OF WEST TO EAST GRIDS ( X-DIRECTION )
C .... JMAX : NUMBER OF SOUTH TO NORTH GRIDS ( Y-DIRECTION )
C .... KMAX : NUMBER OF VERTICAL UPWARD GRIDS FROM THE GROUND SURFACE
C ....      : ( Z-DIRECTION )
C
C .... XX(IMAX-1) :: ANY DISTANCE IN METERS BETWEEN I,J,K NODES.  FOR
C .... YY(JMAX-1)  : EXAMPLE, XX(1) IS THE DISTANCE BETWEEN I=1 AND I=2,
C .... ZZ(KMAX-1)  : AND YY(14) IS THE DISTANCE BETWEEN J=14 AND J=15 .
C
C .... H(IMAX,JMAX) : GROUND ELEVATION IN METERS AT EACH (I,J) LOCATION
C ....              : FROM THE REFERENCE LEVEL OF H(1,1) = 0.0 .
C
C .... NM      : NUMBER OF LOCATIONS AT WHICH WIND VELOCITIES ARE MEASURED
C .... XM(NM) :: RESPECTIVELY, X,Y,Z COORDINATES OF EACH LOCATION
C .... YM(NM)  : ( 1 TO NM ) IN METERS AT WHICH WIND VELOCITIES ARE
C .... ZM(NM)  : MEASURED, WHERE X=Y=Z=0 METERS AT I=J=K=1.
C .... UM(NM) :: RESPECTIVELY, U,V, AND  W-COMPONENTS OF MEASURED
C .... VM(NM)  :: WIND VELOCITY IN METERS PER SECOND AT EACH
C .... WM(NM)  : XM, YM, AND ZM LOCATIONS.
C
C **** THERE ARE TWO TYPES OF WIND FIELD INTERPOLATION SCHEME FOR
C **** INITIAL ESTIMATE DEPENDING UPON THE CHOICE OF "IINTEP" OPTION,
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```
C **** 1 OR 2.
C
C .... IF IINTEP = 1  : A SIMPLE DIRECT NON-LINEAR (EXPONENTIAL)
C ....                : DISTANCE-BASED INTERPOLATION IS USED FOR ALL
C ....                : THE THREE COMPONENTS OF LOCAL WIND.
C ....                : THE WEIGHTING FACTOR "WEIGHT" MUST BE SPECIFIED
C ....                : FOR THIS OPTION BUT "POWER" FACTOR IS UNUSED.
C
C .... IF IINTEP = 2  : THE VERTICAL WIND PROFILE IS ASSUMED TO FOLLOW
C ....                : THE POWER LAW AND HORIZONTALLLY INTERPOLATED
C ....                : USING NON-LINEAR (DISTANCE**-2) INTERPOLATION.
C ....                : VERTICAL COMPONENT, W(I,J,K) IS SET EQUAL TO
C ....                : ZERO EVERYWHERE LETTING THE ENFORCEMENT OF
C ....                : CONTINUITY TAKE CARE OF IT IN THE SUBSEQUENT
C ....                : OPTIMIZATION.  THIS OPTION REQUIRES THAT THE
C ....                : EXPONENT OF THE POWER-LAW "POWER" BE SPECIFIED
C ....                : BUT THE "WEIGHT" FACTOR IS UNUSED.  A GUIDELINE
C ....                : OF THE MAGNITUDE OF "POWER" IS GIVEN BELOW :
C
C---------------+-------------+-----------------+--------+-------+----------
C   SURFACE    ; HEIGHT RANGE; SUPERADIABATIC; NEUTRAL; STABLE; INVERSION
C---------------+-------------+-----------------+--------+-------+----------
C      MEADOWS :   10 -  70  :        0.25      :  0.27 :  ...  :  0.61
C  FLAT FIELD :   11 -  49  :        0.16      :  0.20 :  0.25 :  0.36
C GRASS FIELD :    8 - 120  :        0.14      :  0.17 :  0.27 : .32-.77
C    AIRFIELD :    9 -  27  :        0.09      :  0.08 :  0.18 :  ...
C      DESERT :    6 -  61  :        0.15      :  0.13 :  0.22 :  ...
C WOODED AREA :   11 - 124  :        0.19      :  0.29 :  0.35 :  ...
C---------------+-------------+-----------------+--------+-------+----------
C
C .... WEIGHT : WEIGHTING FACTOR FOR WIND FIELD INTERPOLATION
C .... OMEGAL : OVER-RELAXATION FACTOR FOR WIND-FIELD COMPUTATION
C .... EPSL   : RELATIVE ERROR TOLERANCE FOR WIND-FIELD COMPUTATION
C .... POWER  : EXPONENT OF THE WIND PROFILE POWER-LAW ( SEE ABOVE )
C .... ITMAXL : MAXIMUM NUMBER OF SOR ITERATION FOR WIND COMPUTATION
C
C **** THE FOLLOWING INPUTS ARE REQUIRED ONLY WHEN "COMPC" = 'YES ' .
C
C **** THERE ARE FOUR TYPES OF APPARENT EDDY DIFFUSIVITY SPECIFICATION
C **** IN THE SPACE DEPENDING UPON THE CHOICE OF "IDISP" OPTION, 1 TO 4.
C
C .... IF IDISP = 1  : DIFFUSIVITY IS CONSTANT THROUGHOUT THE DOMAIN.
C ....               : ONLY ONE VALUE OF "CK" IS READ IN.
C
C .... IF IDISP = 2  : HORIZONTAL AND VERTICAL DIFFUSIVITIES ARE
C ....               : SPECIFIED.  TWO VALUES "CKH" AND "CKV"
C ....               : ARE READ IN.
C
C .... IF IDISP = 3  : HORIZONTAL DIFFUSIVITY IS CONSTANT BUT VERTICAL
C ....               : DIFFUSIVITY IS A FUNCTION OF HEIGHT ABOVE GROUND.
C ....               : "CKH" AND "AKZ(1,1,K), K = 1, KMAX" ARE READ IN.
C
C .... IF IDISP = 4  : DIFFUSIVITY IS FULLY SPACE-DEPENDENT. AKX(I,J,K),
C ....               : AKY(I,J,K), AND AKZ(I,J,K) MUST BE READ IN FOR
C ....               : EACH NODE POINT.
C
C **** SELECTION OF "IDISP" OPTION AND VALUES OF DIFFUSIVITIES MUST BE
C **** DETERMINED BY USER BASED ON SOUND LOGICAL CONSIDERATIONS OF WIND
C **** SPEED, TURBULENCE LEVEL, STABILITY, AND ROUGHNESS OF TERRAIN.
C **** DIFFUSIVITIES HAVE THE UNIT OF METER**2/SEC.
C **** IT SHOULD BE NOTED ,HOWEVER, THAT ASSIGNED MAGNITUDES OF
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C **** DIFFUSIVITIES MAY NOT BE SUFFICIENTLY LARGE ENOUGH TO MEET THE
C **** STATIC STABILITY REQUIREMENT( I.E. D .GT. ABS( U*DX /2 )),
C **** DURING THE EXECUTION OF THIS ALGORITHM, THIS STABILITY CONDITION
C **** IS AUTOMATICALLY ENFORCED FOR EACH I-J-K NODE DEPENDING UPON
C **** GRID DISTANCES AND LOCAL WIND VELOCITY COMPONENTS.
C **** ACTUAL DIFFUSIVITIES USED IN THE COMPUTATION MAY, THEREFORE,
C **** DIFFER CONSIDERABLY FROM WHAT ARE ASSIGNED INITIALLY.
C
C .... CK : CONSTANT DIFFUSIVITY (ONLY WHEN IDISP=1)
C .... CKH AND CKV : HORIZONTAL AND VERTICAL DIFFUSIVITIES
C ....             : ( ONLY WHEN IDISP=2 )
C .... CKH AND ( AKZ(1,1,K), K=1,KMAX ) : HORIZONTAL CONSTANT
C ....        DIFFUSIVITY AND HEIGHT-DEPENDENT VERTICAL DIFFUSIVITIES
C ....        ( ONLY WHEN IDISP=3 )
C .... AKX(IMAX,JMAX,KMAX), AKY(IMAX,JMAX,KMAX), AND AKZ(IMAX,JMAX,KMAX)
C ....     : SPACE-DEPENDENDENT DIFFUSIVITIES ( ONLY WHEN IDISP=4 )
C
C .... MC        : NUMBER OF POLLUTANT SOURCE LOCATIONS
C .... IS(MC)    : LOCATIONS OF EACH SOURCE EXPRESSED IN TERMS OF I,J,K
C .... JS(MC)    : NODE NUMBERS FOR EACH OF MC LOCATIONS RESPECTIVELY
C .... KS(MC)    :
C .... SC(MC)    : SOURCE STRENGTH AT EACH OF MC SOURCE LOCATIONS (CC/SEC)
C **** IMPORTANT !   SOURCES MUST BE LOCATED WITHIN THE FOLLOWING RANGE.
C **** IS(MC) .GE. 3 .AND. IS(MC) .LE. (IMAX-2)
C **** JS(MC) .GE. 3 .AND. JS(MC) .LE. (JMAX-2)
C **** KS(MC) .GE. 1 .AND. KS(MC) .LE. (KMAX-2)
C
C .... EPSC   : RELATIVE ERROR TOLERANCE FOR CONC. COMPUTATION
C .... ITMAXC : MAXIMUM NUMBER OF SOR ITERATION FOR CONC. COMPUTATION
C .... ZLEVEL : HEIGHT ABOVE GROUND AT WHICH HORIZONTAL CONC. PROFILE
C ....        : IS TO BE PLOTTED. ( UNUSED IF PLT = 'NO  ' )
C .... BCKGRD : BACKGROUND POLLUTANT CONCENTRATION IN PPM
C
C............................ INPUT SEQUENCE .........................
C
C--------+--------------+-------------------------------------+-----------
C INPUT  :    NO. OF    :          INPUT PARAMETERS           :   FORMAT
C GROUP  : CARD-IMAGES  :                                     :
C--------+--------------+-------------------------------------+-----------
C   1    :      1       : TITLE                               : 20A4
C--------+--------------+-------------------------------------+-----------
C   2    :      1       : IDUMP,CUMPC,PECHO,PINTER,PLAMBD,    : 3A4,11(1X,
C        :              : PDIVK,PCONC,PLT                     : A3),1X,I1)
C--------+--------------+-------------------------------------+-----------
C   3    :      1       : IMAX,JMAX,KMAX                      : 3I5
C--------+--------------+-------------------------------------+-----------
C   4    : (IMAX-1)/10  : (XX(I),I=1,IM1)                     : 10F8.0
C--------+--------------+-------------------------------------+-----------
C   5    : (JMAX-1)/10  : (YY(J),J=1,JM1)                     : 10F8.0
C--------+--------------+-------------------------------------+-----------
C   6    : (KMAX-1)/10  : (ZZ(K),K=1,KM1)                     : 10F8.0
C--------+--------------+-------------------------------------+-----------
C   7    : (IMAX*JMAX)  : ((H(I,J),I=1,IMAX,J=1,JMAX)         : 10F8.0
C        :      /10     :                                     :
C--------+--------------+-------------------------------------+-----------
C   8    :      1       : NM                                  : I5
C--------+--------------+-------------------------------------+-----------
C   9    :     NM       : ((XM(I),YM(I),ZM(I),UM(I),VM(I),    : 6F10.0
C        :              :    WM(I)),I=1,NM)                   :
C--------+--------------+-------------------------------------+-----------
C  10    :      1       : IINTSP,WEIGHT,OMEGAL,EPSL,          : I5,4F8.0,I5
```

```
C         :               : POWER,ITMAXL                             :
C----------------------------------------------------------------------
C     THE FOLLOWING INPUTS ARE REQUIRED ONLY IF "COMPC" = 'YES '
C----------------------------------------------------------------------
C  11     :       1       : MC                                       : I8
C-------+---------------+----------------------------------------+-----------
C  12     :      MC       : ((IS(I),JS(I),KS(I),SC(I)),I=1,MC) : 3I8,F8.0
C-------+---------------+----------------------------------------+-----------
C  13     :       1       : EPSC,ITMAXC,IDISP,ZLEVEL,BCKGRD        : F8.0,2I8,
C         :               :                                          : 2F8.0
C-------+---------------+----------------------------------------+-----------
C  14     :       1       : CK (ONLY IF "IDISP"=1)                   : F8.0
C-------+---------------+----------------------------------------+-----------
C  15     :       1       : CKH,CKV (ONLY IF "IDISP"=2)              : 2F8.0
C-------+---------------+----------------------------------------+-----------
C  16     :       1       : CKH (ONLY IF "IDISP"=3)                  : F8.0
C-------+---------------+----------------------------------------+-----------
C  17     : KMAX/10       : (AKZ(1,1,K),K=1,KMAX)                    : 10F8.0
C         :               : (ONLY IF "IDISP"=3)                      :
C-------+---------------+----------------------------------------+-----------
C  18     : (IMAX*JMAX    : (((AKX(I,J,K),I=1,IMAX),J=1,JMAX)        : 10F8.0
C         : *KMAX)/10     : ,K=1,KMAX) (ONLY IF "IDISP"=4)           :
C-------+---------------+----------------------------------------+-----------
C  19     : (IMAX*KJMAX   : (((AKY(I,J,K),I=1,IMAX),J=1,JMAX)        : 10F8.0
C         : *KMAX)/10     : ,K=1,KMAX) (ONLY IF "IDISP"=4)           :
C-------+---------------+----------------------------------------+-----------
C  20     : (IMAX*JMAX    : (((AKZ(I,J,K),I=1,IMAX),J=1,JMAX)        : 10F8.0
C         : *KMAX)/10     : ,K=1,KMAX) (ONLY IF "IDISP"=4)           :
C-------+---------------+----------------------------------------+-----------
C
C...................... SOLUTION STRATEGIES AND PRECAUTIONS ...............
C
C .... BECAUSE OF THE NON-UNIFORM, THREE-DIMENSIONAL GRID SPACING
C .... SCHEME USED IN THE ALGORITHM, IT IS CONSIDERABLLY TIME-CONSUMING
C .... TO RUN THIS PROGRAM.  PRESENTLY, IMAX*JMAX*KMAX=9000 IS SET AS
C .... A LIMIT OF GRID SYSTEM.
C .... IT IS RECOMMENDED THAT GRID SYSTEM BE CONSTRUCTED WITHIN THIS
C .... LIMIT UNDER NORMAL CONDITIONS.
C .... THE ERROR TOLERANCES ( EPSL AND EPSC ) SHOULD BE COMPROMISED
C .... AT THE LEVEL OF 0.001 IN ORDER TO SAVE EXECUTION TIME.
C .... IT SHOULD BE NOTED THAT THE NUMBER OF ITERATIONS REQUIRED IS A
C .... FUNCTION OF THE NUMBER OF GRID POINTS AS WELL.
C .... NORMALLY, FOR EPSL=EPSC=0.001, ITMAXL SHOULD BE AT LEAST 200 AND
C .... ITMAXC SHOULD BE AT LEAST 250.
C .... THE OPTIMUM OVER-RELAXATION FACTOR ( OMEGAL ) FOR THE WIND-FIELD
C .... COMPUTATION CANNOT BE PREDETERMINED SINCE IT IS A FUNCTION OF
C .... NUMEROUS FACTORS.  HOWEVER, OMEGAC=1.85 SHOULD BE A GOOD INITIAL
C .... ESTIMATE NORMALLY.  IF THE RELATIVE ERROR VALUE OSCILLATES WITH
C .... LARGE AMPLITUDES, IT MAY WELL BE THAT OMEGAC IS TOO LARGE.
C .... IF THE SOLUTION FOR LAMBDA DIVERGES OR BLOWS UP, TRY OMEGAL=1.0
C .... AT THE COST OF INCREASED NUMBER OF ITERATIONS ( ITMAXL ).
C .... IF IT STILL DOES NOT CONVERGE, SOMETHING ELSE MUST BE WRONG.
C .... FOR THE CONCENTRATION SOLUTION, DIVERGING OR BLOWING UP SOLUTION
C .... INDICATES THAT THE MAGNITUDES OF DIFFUSIVITIES ARE TOO SMALL.
C .... THE NUMERICAL STABILITY REQUIRES THAT THE PECLET CONDITION
C .... BE SATISFIED AT EACH POINT FOR ANY CONVECTIVE-DISPERSION PROBLEM.
C .... THIS CONDITION IS APPROXIMATELY ENFORCED DURING THE EXECUTION
C .... OF THE ALGORITHM AND DIFFUSIVITIES ARE ADJUSTED LOCALLY.
C .... THEREFORE, STABLE CONCENTRATION SOLUTION DOES NOT NECESSARILY
C .... MEAN A CORRECT SOLUTION AND IT IS AN ABUSIVE USE OF THE NON-
C .... UNIFORM GRID SPACING SCHEME TO APPLY TO AN EXCESSIVELY SPACE-
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C .... VARYING (PARTICULARLY IN HORIZONTAL DIRECTION) GRID SYSTEM UNDER
C .... HIGH WIND SPEED CONDITIONS.
C
C.....................................................................
C
C
       INTEGER*2 KUI, KUJ, ILEFTJ, ILEFTK, IRITEJ, IRITEK, JFRNTI,
     &           JFRNTK, JBACKI, JBACKK
       DIMENSION U(15,15,10), V(15,15,10), W(15,15,10), AC(15,15,10),
     &           AKX(15,15,10), AKY(15,15,10), AKZ(15,15,10),
     &           Q(15,15,10), H(15,15), XX(14), YY(14), ZZ(09),
     &           UM(05), VM(05), WM(05), XM(05), YM(05), ZM(05),
     &           IS(05), JS(05), KS(05), SC(05), IJKP(14), RDIS(05),
     &           UP(05,10), VP(05,10), ZK(10), IH(15), IV(15), KUI(225),
     &           KUJ(225), ILEFTJ(135), ILEFTK(135), IRITEJ(135),
     &           IRITEK(135), JFRNTI(135), JFRNTK(135), JBACKI(135),
     &           JBACKK(135), HX12M(135), HXMXM(135), HY12M(135),
     &           HYMXM(135), ZZLR(135), ZZRR(135), ZZFR(135), ZZBR(135)
       COMMON /INPUT/ II, IO, IOT, TDUMP, COMPC, PECHO, PINTER,
     &                PLAMBD, PUVW, PCONC, PLT /HEAD/ TITLE(20)
       COMMON /DIMENN/ IMAX, JMAX, KMAX, IM1, JM1, KM1, IMMM, JMMM, KMMM,
     &                 NM, MC, IJKX, JMIN, JITER, IJMX, MIJ, MIK, MJK
       COMMON /RGWS/ WEIGHT, POWER, IINTEP, UVWT
       COMMON /RELAXL/ OMEGAL, ASEMOL, EPSL, ITMAXL
       COMMON /RELAXC/ EPSC, ITMAXC, IDISP, ZLEVEL, BCKGRD /HVDISP/
     &                 CK, CKH, CKV
       DATA ISIZE / 4000 /, YES / 4HYES /
C
C++++++++++++++  DEFINITION OF I/O UNITS +++++++++++++
C
      II = 1
      IO = 3
      IOT= 9
C
C+++++++++++++++++++++++++++++++++++++++++++++++++++++
C
      READ(II,100) TITLE
      READ(II,100) TDUMP, COMPC, PECHO, PINTER, PLAMBD, PUVW, PCONC, PLT
      READ(II,101) IMAX, JMAX, KMAX
      IF ( IMAX*JMAX*KMAX .GT. ISIZE ) GO TO 90
      IM1 = IMAX - 1
      JM1 = JMAX - 1
      KM1 = KMAX - 1
      IMMM = IM1 - 1
      JMMM = JM1 - 1
      KMMM = KM1 - 1
      MIJ = IMAX * JMAX
      MIK = IMAX * KM1
      MJK = JMAX * KM1
      IJMX = MAX0 ( IMAX, JMAX )
      IJKX = MAX0 ( IM1, JM1, KM1 )
      JMIN = MIN0 ( 15, JMAX )
      JITER = JMAX / 15
      IF ( JMAX .GT. JITER*15 ) JITER = JITER + 1
      READ(II,102) ( XX(I), I = 1,IM1 )
      READ(II,102) ( YY(I), I = 1,JM1 )
      READ(II,102) ( ZZ(I), I = 1,KM1 )
      ZK(1) = 0.0
      DO 7 K = 2, KMAX
      ZK(K) = ZK(K-1) + ZZ(K-1)
    7 CONTINUE
```

```
      READ(II,102) ( ( H(I,J), I=1,IMAX ), J=1,JMAX )
      READ(II,101) NM
      READ(II,103) ( ( XM(I), YM(I), ZM(I), UM(I), VM(I), WM(I) ),
     &               I = 1, NM )
      READ(II,105) IINTEP, WEIGHT, OMEGAL, EPSL, POWER, ITMAXL
      IF ( IINTEP .LT. 1 .OR. IINTEP. GT. 2 ) GO TO 97
      IF ( OMEGAL .GT. 2. .OR. OMEGAL .LT. 1. ) GO TO 93
      IF ( IINTEP .NE. 2 ) GO TO 6
      IF ( POWER .LT. .08 .OR. POWER .GT. .77 ) GO TO 96
    6 AGEMOL = OMEGAL - 1.0
C
      IF ( COMPC .NE. YES ) GO TO 5
      READ (II,101) MC
      READ(II,104) ( ( IS(I), JS(I), KS(I), SC(I) ), I = 1, MC )
      DO 15 I = 1, MC
      IF ( IS(I) - 3 ) 91, 16, 16
   16 IF ( JS(I) - 3 ) 91, 17, 17
   17 IF ( IMMM - IS(I) ) 91, 18, 18
   18 IF ( JMMM - JS(I) ) 91, 19, 19
   19 IF ( KMMM - KS(I) ) 91, 15, 15
   15 CONTINUE
      READ(II,106) EPSC, ITMAXC, IDISP, ZLEVEL, BCKGRD
      IF ( IDISP .LT. 1 .OR. IDISP .GT. 4 ) GO TO 95
      GO TO ( 1,2,3,4 ), IDISP
    1 READ(II,102) CK
      GO TO 5
    2 READ(II,102) CKH, CKV
      GO TO 5
    3 READ(II,102) CKH
      READ(II,102) ( AKZ(1,1,K), K = 1, KMAX )
      GO TO 5
    4 READ(II,102) ( ( ( AKX(I,J,K),I=1,IMAX ).J=1,JMAX ),K=1,KMAX )
      READ(II,102) ( ( ( AKY(I,J,K),I=1,IMAX ),J=1,JMAX ),K=1,KMAX )
      READ(II,102) ( ( ( AKZ(I,J,K),I=1,IMAX ),J=1,JMAX ),K=1,KMAX )
    5 CONTINUE
C
      DO 10 I = 1, IMAX
      DO 10 J = 1, JMAX
      DO 10 K = 1, KMAX
      U (I,J,K) = 0.0
      V (I,J,K) = 0.0
      W (I,J,K) = 0.0
      AC(I,J,K) = 0.0
   10 CONTINUE
      UVWT = 0.0
      IF ( NM .EQ. 0 ) GO TO 13
      DO 12 I = 1, NM
      UVWT = ABS ( UM(I) ) + ABS( VM(I) ) + ABS ( WM(I) ) + UVWT
   12 CONTINUE
   13 CONTINUE
      DO 11 I = 2, IM1
      DO 11 J = 2, JM1
      DO 11 K = 1, KM1
      AC(I,J,K) = 1.0
   11 CONTINUE
C
      CALL PRINTS ( PECHO, 1, U, V, W, H, AC, XX, YY, ZZ, UM, VM, WM,
     &              XM, YM, ZM, IS, JS, KS, SC, AKX, AKY, AKZ, ZK, IJKP )
C
      CALL INTERP ( U, V, W, H, XX, YY, ZZ, UM, VM, WM, XM, YM, ZM,
     &              RDIS, UP, VP )
```

```
C
      CALL PRINTS ( PINITR, 2, U, V, W, H, AC, XX, YY, ZZ, UM, VM, WM,
     &              XM, YM, ZM, IS, JS, KS, SC, AKX, AKY, AKZ, ZK, IJKP )
C
      CALL STREAM ( U, V, W, H, AC, XX, YY, ZZ )
C
      CALL PRINTS ( PLAMPH, 3, U, V, W, H, AC, XX, YY, ZZ, UM, VM, WM,
     &              XM, YM, ZM, IS, JS, KS, SC, AKX, AKY, AKZ, ZK, IJKP )
C
      CALL UVW    ( U, V, W, H, AC, XX, YY, ZZ )
C
      CALL PRINTS ( PUVW, 4, U, V, W, H, AC, XX, YY, ZZ, UM, VM, WM,
     &              XM, YM, ZM, IS, JS, KS, SC, AKX, AKY, AKZ, ZK, IJKP )
C
      IF ( COMPC .NE. YES ) GO TO 22
C
      CALL STACON ( U, V, W, H, AC, XX, YY, ZZ, IS, JS, KS, SC, C,
     &              AKX, AKY, AKZ, KILL, [illegible], IERITJ, IERITK, IPRTIJ,
     &              IPRTIK, JPRNTI, JPRNTK, JBACKI, JBACKK, HXIZM,
     &              HXMXM, HYIZM, HYMXM, ZZLR, ZZRR, ZZFR, ZZBR )
C
      CALL PRINTS ( PCONC, 5, U, V, W, H, AC, XX, YY, ZZ, UM, VM, WM,
     &              XM, YM, ZM, IS, JS, KS, SC, AKX, AKY, AKZ, ZK, IJKP )
C
      IF ( PLT .NE. YES ) GO TO 20
C
      CALL PLOTTR ( AC, IH, IV, XX, YY, ZZ, 0 )
C
   20 S T O P
C
   90 WRITE(IO,200)
      GO TO 20
   91 WRITE(IO,201)
      GO TO 20
   93 WRITE(IO,203)
      GO TO 20
   95 WRITE(IO,205)
      GO TO 20
   96 WRITE(IO,206)
      GO TO 20
   97 WRITE(IO,207)
      GO TO 20
  100 FORMAT( 20A4 )
  101 FORMAT( 10I8 )
  102 FORMAT( 10F8.2 )
  103 FORMAT( 6F8.0 )
  104 FORMAT( 3I8,F8.0 )
  105 FORMAT( I8,4F8.0,I8 )
  106 FORMAT( F8.0,2I8,2F8.0 )
  200 FORMAT( 1H0,' ARRAY SIZE TOO LARGE *** RUN ABORTED. ***',//,
     &        '  THIS IS A PROTECTIVE MEASURE TO PREVENT AN ',
     &        'INADVERTENT RUN OF EXCESSIVELY TIME-CONSUMING JOB.',/,
     &        '  IT IS ADVISABLE TO REARRANGE THE GRID SYSTEM.',
     &        '  HOWEVER, IF ABSOLUTELY NECESSARY, ',/,'  CHANGE THE ',
     &        'LIMIT ( ISIZE ) IN THE DATA STATEMENT.',/,'  BUT MAKE ',
     &        'A COMMITMENT FOR EXECUTION TIME IN SUCH A CASE.' )
  201 FORMAT ( 1H0,' SOURCE LOCATION(S) MUST BE WITHIN THE FOLLOWING ',
     &        'RANGE.  *** RUN ABORTED. ***',//,2X,'IS(MC) .GE. 3 .'
     &        'AND. IS(MC) .LE. (IMAX-2)',/,2X,'JS(MC) .GE. 3 .AND. ',
     &        'JS(MC) .LE. (JMAX-2)',/,2X,'KS(MC) .GE. 1 .AND. KS(MC)',
     &        ' .LE. (KMAX-2)' )
```

```
 203 FORMAT( 1H0,' OVER RELAXATION FACTOR (OMEGAL) MUST BE',
    &         ' BETWEEN 1.0 AND 2.0 *** RUN ABORTED.' )
 205 FORMAT( 1H0,' DIFFUSIVITY TYPE OPTION, IDISP, MUST BE',
    &         ' 1 OR 2 OR 3 OR 4  **** RUN ABORTED. ****' )
 206 FORMAT( 1H0,' THE EXPONENT OF THE WIND PROFILE POWER LAW IS',
    &           ' NORMALLY BETWEEN 0.07 AND 0.77  *** RUN ABORTED.' )
 207 FORMAT( 1H0,' THE WIND INTERPOLATION OPTION, IINTEP, MUST BE',
    &        ' 1 OR 2  *** RUN ABORTED. ***' )
     E  N  D
C
C
     SUBROUTINE INTERP ( UB, VB, WB, H, XX, YY, ZZ, UM, VM, WM,
    &                    XM, YM, ZM, ROIS, UP, VP )
     COMMON /DIMENN/ IMAX, JMAX, KMAX, IM, JM, KM, IMMM, JMMM, KMMM,
    &                N, MC, IJKX, JMIN, JITER, IJMX, MIJ, MIK, MJK
     COMMON /INOUT/ II, IO, ID, D1,D2,D3,D4,D5,D6,D7,D8
     COMMON /RGWS/ WT, POWER, IINTEP, UVWT
     DIMENSION UB(IMAX,JMAX,KMAX), VB(IMAX,JMAX,KMAX),
    &          WB(IMAX,JMAX,KMAX), H(IMAX,JMAX), XX(IM), YY(JM),
    &          ZZ(KM), UM(N), VM(N), WM(N), XM(N), YM(N), ZM(N),
    &          ROIS(N), UP(N,KMAX), VP(N,KMAX)
     IF ( UVWT .EQ. 0.0 ) RETURN
     IF ( IINTEP-1 ) 10, 10, 50
  10 CONTINUE
     DO 1 I = 1, IMAX
     IF ( I-1 ) 2, 2, 3
   2 RI = 0.
     GO TO 4
   3 RI = RI + XX(I-1)
   4 DO 1 J = 1, JMAX
     IF ( J-1 ) 5, 5, 6
   5 RJ = 0.
     GO TO 7
   6 RJ = RJ + YY(J-1)
   7 RK = 0.
     DO 1 K = 2, KMAX
     RK = RK + ZZ(K-1) + H(I,J)
     SIGMWI = 0.
     SIGMUA = 0.
     SIGMVA = 0.
     SIGMWA = 0.
C
     DO 20 L = 1, N
     ARG = SQRT ( (RI-XM(L))**2 + (RJ-YM(L))**2 + (RK-ZM(L))**2 ) * WT
     IF ( ARG - 100. ) 21, 25, 25
  21 WI = EXP ( -ARG )
     SIGMWI = SIGMWI + WI
     SIGMUA = SIGMUA + WI * UM(L)
     SIGMVA = SIGMVA + WI * VM(L)
     SIGMWA = SIGMWA + WI * WM(L)
  20 CONTINUE
     GO TO 30
  25 WRITE(IO,300)
     WRITE(IO,100) WT
     WT = WT * 0.5
     WRITE(IO,200) WT
     WRITE(IO,300)
     GO TO 10
  30 UB(I,J,K) = SIGMUA / SIGMWI
     VB(I,J,K) = SIGMVA / SIGMWI
     WB(I,J,K) = SIGMWA / SIGMWI
```

```
    1 CONTINUE
      RETURN
   50 CONTINUE
      DO 60 L = 1, N
      HEIGHT = 0.
      ZL = ZM(L)
      IF ( ZL .LE. 0. ) ZL = 0.1
      DO 60 K = 2, KMAX
      HEIGHT = HEIGHT + ZZ(K-1)
      HPOWER = ( HEIGHT / ZL ) ** POWER
      UP(L,K) = UM(L) * HPOWER
      VP(L,K) = VM(L) * HPOWER
   60 CONTINUE
      DO 51 I = 1, IMAX
      IF ( I-1 ) 52, 52, 53
   52 RI = 0.
      GO TO 54
   53 RI = RI + XX(I-1)
   54 DO 51 J = 1, JMAX
      IF ( J-1 ) 55, 55, 56
   55 RJ = 0.
      GO TO 57
   56 RJ = RJ + YY(J-1)
   57 SUM = 0.0
      DO 70 L = 1, N
      RIX = ( RI - XM(L) ) ** 2
      RJY = ( RJ - YM(L) ) ** 2
      IF ( RIX .LE. 0.0 ) RIX = 0.1
      IF ( RJY .LE. 0.0 ) RJY = 0.1
      RDIS(L) = 1.0 / ( RIX + RJY )
      SUM = SUM + RDIS(L)
   70 CONTINUE
      DO 71 K = 2, KMAX
      UB(I,J,K) = 0.
      VB(I,J,K) = 0.
      WB(I,J,K) = 0.
      DO 72 L = 1, N
      RDLSUM = RDIS(L) / SUM
      UB(I,J,K) = UB(I,J,K) + UP(L,K) * RDLSUM
      VB(I,J,K) = VB(I,J,K) + VP(L,K) * RDLSUM
   72 CONTINUE
   71 CONTINUE
   51 CONTINUE
      RETURN
  100 FORMAT ( 1H0,35X,'THE WEIGHTING FACTOR (WEIGHT) = ',E11.3,
     &             ' IS TOO LARGE FOR THIS GRID-DISTANCE SYSTEM.' )
  200 FORMAT( 1H0,35X,'THE FACTOR WILL BE HALVED TO : WEIGHT = ',
     &             E11.3,'  ..........' )
  300 FORMAT ( 1H0,1X,64('- ') )
      E N D
C
C
      SUBROUTINE SORLAX ( UB, VB, WB, H, AL, XX, YY, ZZ )
      COMMON /DIMENS/ IMAX, JMAX, KMAX, IMM, JMM, KMM, IMMM, JMMM, KMMM,
     &                 NM, NC, IJKX, JMIN, JITER, IJMX, MIJ, MIK, MJK
      COMMON /RELAXL/ OMEGA, ASEMD, EPS, ITMAX
      COMMON /INPUT/ II, IO, IOT, D1,D2,D3,D4,D5,D6,D7,D8
      COMMON /RGWS/ DUM1, DUM2, IDUM, DUM3
      DIMENSION UB(IMAX,JMAX,KMAX), VB(IMAX,JMAX,KMAX),
     &          WB(IMAX,JMAX,KMAX), H(IMAX,JMAX), AL(IMAX,JMAX,KMAX),
     &          XX(IMM), YY(JMM), ZZ(KMM)
```

```
      IST = MAX0 ( ITMAX-50, 20 )
      IF ( DUMB .EQ. 0.0 ) RETURN
      ZZ1R = 2. / ZZ(1)
      C1C = ZZ1R / ZZ(1)
C
      DO 100 IT = 1, ITMAX
      ERMAX = 0.0
C
      DO 10 I = 2, IMM
      IM = I - 1
      IP = I + 1
      DX = XX(I)
      DXM = XX(IM)
      ALPHA = DXM / DX
      ALP1 = ALPHA + 1.0
      DAP1 = DX * ALP1
      F1X = ALPHA / DAP1
      F2X = ( 1. - ALPHA ) / DXM
      F3X = - ( F1X + F2X )
      S1X = 2. / ( DX * DAP1 )
      S2X = -2. / ( DX * DXM )
      S3X = - ( S1X + S2X )
C
      DO 10 J = 2, JMM
      JM = J - 1
      JP = J + 1
      DY = YY(J)
      DYM = YY(JM)
      BETA = DYM / DY
      BET1 = BETA + 1.
      DBT1 = DY * BET1
      F1Y = BETA / DBT1
      F2Y = ( 1. - BETA ) / DYM
      F3Y = - ( F1Y + F2Y )
      S1Y = 2. / ( DY * DBT1 )
      S2Y = -2. / ( DY * DYM )
      S3Y = - ( S1Y + S2Y )
C
      HIJ = H(I,J)
      HX = F1X * H(IP,J) + F2X * HIJ + F3X * H(IM,J)
      HY = F1Y * H(I,JP) + F2Y * HIJ + F3Y * H(I,JM)
      HXX = S1X * H(IP,J) + S2X * HIJ + S3X * H(IM,J)
      HYY = S1Y * H(I,JP) + S2Y * HIJ + S3Y * H(I,JM)
C
      C1 = 1. + HX*HX + HY*HY
      C2 = -2. * HX
      C3 = -2. * HY
      C4 = -HXX - HYY
      S2XY = S2X + S2Y
      C1CC1 = C1 * C1C
C
      DO 10 K = 1, KMM
      ALPIJK = AL(I,J,K)
      KM = K - 1
      IF ( KM ) 11, 12, 11
   11 KP = K + 1
      UBIJK = UB(I,J,K)
      VBIJK = VB(I,J,K)
      UBX = F1X * UB(IP,J,K) + F2X *    UBIJK   + F3X * UB(IM,J,K)
      VBY = F1Y * VB(I,JP,K) + F2Y *    VBIJK   + F3Y * VB(I,JM,K)
      DZ = ZZ(K)
```

```
      DZM = ZZ(KM)
      GAMMA = DZM / DZ
      GAM1 = GAMMA + 1.
      DGAM1 = DZ * GAM1
      F1Z = GAMMA / DGAM1
      F2Z = ( 1. - GAMMA ) / DZM
      F3Z = - ( F1Z + F2Z )
      S1Z = 2. / ( DZ * DGAM1 )
      S2Z = -2. / ( DZ * DZM )
      S3Z = - ( S1Z + S2Z )
      UBZ = F1Z * UB(I,J,KP) + F2Z *   UBIJK    + F3Z * UB(I,J,KM)
      VBZ = F1Z * VB(I,J,KP) + F2Z *   VBIJK    + F3Z * VB(I,J,KM)
      WBZ = F1Z * WB(I,J,KP) + F2Z * WB(I,J,K) + F3Z * WB(I,J,KM)
      C5  =  ( UBX - HX * UBZ + VBY - HY * VBZ + WBZ ) * 2.
      C2FZ1 = C2 * F1Z
      C2FZ2 = C2 * F2Z
      C2FZ3 = C2 * F3Z
      C3FZ1 = C3 * F1Z
      C3FZ2 = C3 * F2Z
      C3FZ3 = C3 * F3Z
      DENOM =    S2XY     + C1*S2Z + C2FZ2*F2X + C3FZ2*F2Y + C4*F2Z
C
      AL(I,J,K) =    ( - ( C1*S1Z + C2FZ1*F2X + C3FZ1*F2Y +  C4*F1Z ) *
     &              AL(I,J,KP)
     &                  - ( C1*S3Z + C2FZ3*F2X + C3FZ3*F2Y + C4*F3Z ) *
     &              AL(I,J,KM)
     &                  - ( S3Y + C3FZ2*F3Y ) * AL(I,JM,K)
     &                  - ( S1X + C2FZ2*F1X ) * AL(IP,J,K)
     &                  - ( S1Y + C3FZ2*F1Y ) * AL(I,JP,K)
     &                  - ( S3X + C2FZ2*F3X ) * AL(IM,J,K)
     &                  - C2FZ1 * ( F1X*AL(IP,J,KP) + F3X*AL(IM,J,KP) )
     &                  - C2FZ3 * ( F1X*AL(IP,J,KM) + F3X*AL(IM,J,KM) )
     &                  - C3FZ1 * ( F1Y*AL(I,JP,KP) + F3Y*AL(I,JM,KP) )
     &                  - C3FZ3 * ( F1Y*AL(I,JP,KM) + F3Y*AL(I,JM,KM) )
     &                  - C5 ) / DENOM    * OMEGA - AGEMO * ALPIJK
      GO TO 13
C
   12 AL(I,J,1) = ( - ( S1X*AL(IP,J,1) + S3X*AL(IM,J,1)
     &                  + S1Y*AL(I,JP,1) + S3Y*AL(I,JM,1)
     &                  + C1CC1 *    AL(I,J,2) )
     &              + ZZ1R * ( HX*UB(I,J,2) + HY*VB(I,J,2) - WB(I,J,2) ) )
     &              / ( S2XY - C1CC1 ) * OMEGA - AGEMO * ALPIJK
C
   13 IF ( IT-IST ) 10, 15, 15
   15 ERROR = ABS ( AL(I,J,K)/ALPIJK - 1. )
      IF ( ERROR - ERMAX ) 10, 10, 16
   16 ERMAX = ERROR
   10 CONTINUE
C
      IF ( IT-IST ) 100, 98, 99
   98 WRITE(IO,200)
   99 WRITE(IO,201) IT, ERMAX
      IF ( ERMAX-EPS ) 101, 101, 102
  102 IF ( ERMAX .GT. 1.0E+02 ) GO TO 105
  100 CONTINUE
C
      ERATIO = ERMAX / EPS
      WRITE(IO,202) ITMAX, ERATIO
      IF ( ERATIO-10.) 104, 104, 103
  103 WRITE(IO,203)
      STOP
```

```
  101 WRITE(IO,205)
      WRITE(IO,206)
      RETURN
  104 WRITE(IO,204)
      WRITE(IO,206)
      RETURN
  105 WRITE(IO,207) IT, ERMAX
      STOP
C
  200 FORMAT( 1H0, / ,20X,'CONVERGENCE TREND OF LAMBDA-SOR',//,
     &            20X,'ITERATION NO.',12X,'RELATIVE ERROR' )
  201 FORMAT( 24X,I4,17X,F11.7 )
  202 FORMAT( /,20X, 'NO CONVERGENCE AT ',I3,' ITERATIONS WITH MAX. ER'
     &,'ROR/EPS = ',F10.3,//,20X,'RELAXATION FACTOR (OMEGAL) MAY HAVE'
     &,' BEEN A BAD CHOICE.',// )
  203 FORMAT( 10X,'ERROR VALUE TOO LARGE FOR CONTINUED COMPUTATION    ',
     &            '*************   RUN ABORTED.   **************',// )
  204 FORMAT( 10X,'COMPUTATION WILL PROCEED ALTHOUGH THE ERROR VALUE',
     &            ' IS ONE-ORDER LARGER THAN SPECIFIED.',/ )
  205 FORMAT( 1H0,09X,'LAMBDA-SOR CONVERGED !!' )
  206 FORMAT ( 1H0,1X,64('- ') )
  207 FORMAT (1H0,9X,'ITERATION = ',I3,', AND MAX. ERROR = ',F11.7,/,
     &         10X,'CONVERGENCE OUTLOOK IS VERY DIM ... RUN ABORTED.')
      E N D
C
C
      SUBROUTINE UVW ( U, V, W, H, A, XX, YY, ZZ )
      COMMON /DIMENN/ IMX, JMX, KMX, IMM, JMM, KMM, IMMM, JMMM, KMMM,
     &                NM, MC, IJKX, JMIN, JITER, IJMX, MIJ, MIK, MJK
      COMMON /RGWS/ DUM1, DUM2, IDUM, DUM3
      DIMENSION U(IMX,JMX,KMX), V(IMX,JMX,KMX), W(IMX,JMX,KMX),
     &      H(IMX,JMX), A(IMX,JMX,KMX), XX(IMM), YY(JMM), ZZ(KMM)
      IF ( DUM3 .EQ. 0.0 ) RETURN
      ALPU = XX(IMMM) / XX(IMM)
      BETU = YY(JMMM) / YY(JMM)
      GAMU = ZZ(KMMM) / ZZ(KMM)
      ALPD = XX(1) / XX(2)
      BETD = YY(1) / YY(2)
      ALP1U = ALPU + 1.
      BET1U = BETU + 1.
      GAM1U = GAMU + 1.
      ALP1D = ALPD + 1.
      BET1D = BETD + 1.
      FX1U = ( 2. + ALPU ) / ( XX(IMM) * ALP1U )
      FX2U = -ALP1U / XX(IMMM)
      FX3U = - ( FX1U + FX2U )
      FY1U = ( 2. + BETU ) / ( YY(JMM) * BET1U )
      FY2U = - BET1U / YY(JMMM)
      FY3U = - ( FY1U + FY2U )
      FZ1U = ( 2. + GAMU ) / ( ZZ(KMM) * GAM1U )
      FZ2U = - GAM1U / ZZ(KMMM)
      FZ3U = - ( FZ1U + FZ2U )
      FX1D = - ALPD / ( XX(2) * ALP1D )
      FX2D = ALP1D / XX(1)
      FX3D = - ( FX1D + FX2D )
      FY1D = - BETD / ( YY(2) * BET1D )
      FY2D = BET1D / YY(1)
      FY3D = - ( FY1D + FY2D )
C
      DO 10 I = 1, IMX
      IM = I - 1
```

```
      IP = I + 1
      IF ( IM ) 11, 11, 12
   12 IF ( I-IMX ) 14, 13, 13
   13 IDX = 1
      GO TO 15
   11 IDX = -1
      GO TO 15
   14 IDX = 0
      DX = XX(I)
      DXM = XX(IM)
      ALPHA = DXM / DX
      FX1 = ALPHA / ( DX * ( ALPHA + 1. ) )
      FX2 = ( 1. - ALPHA ) / DXM
      FX3 = - ( FX1 + FX2 )
   15 CONTINUE
C
      DO 10 J = 1, JMX
      JM = J - 1
      JP = J + 1
      IF ( JM ) 21, 21, 22
   22 IF ( J-JMX ) 24, 23, 23
   23 IDY = 1
      GO TO 25
   21 IDY = -1
      GO TO 25
   24 IDY = 0
      DY = YY(J)
      DYM = YY(JM)
      BETA = DYM / DY
      FY1 = BETA / ( DY * ( BETA + 1. ) )
      FY2 = ( 1. - BETA ) / DYM
      FY3 = - ( FY1 + FY2 )
C
   25 IF ( IDX ) 30, 31, 32
   30 HX = FX1D* H(3,J) + FX2D* H(2,J) + FX3D* H(1,J)
      GO TO 35
   31 HX = FX1 * H(IP,J) + FX2 * H(I,J) + FX3 * H(IM,J)
      GO TO 35
   32 HX = FX1U* H(IMX,J) + FX2U* H(IMM,J) + FX3U* H(IMMM,J)
   35 IF ( IDY ) 40, 41, 42
   40 HY = FY1D* H(I,3) + FY2D* H(I,2) + FY3D* H(I,1)
      GO TO 45
   41 HY = FY1 * H(I,JP) + FY2 * H(I,J) + FY3 * H(I,JM)
      GO TO 45
   42 HY = FY1U* H(I,JMX) + FY2U* H(I,JMM) + FY3U* H(I,JMMM)
   45 CONTINUE
C
      DO 10 K = 2, KMX
      KM = K - 1
      KP = K + 1
      IF ( K - KMX ) 54, 53, 53
   54 DZ = ZZ(K)
      DZM = ZZ(KM)
      GAMA = DZM / DZ
      FZ1 = GAMA / ( DZ * ( GAMA + 1. ) )
      FZ2 = ( 1. - GAMA ) / DZM
      FZ3 = - ( FZ1 + FZ2 )
      AZ = FZ1 * A(I,J,KP) + FZ2 * A(I,J,K) + FZ3 * A(I,J,KM)
      GO TO 55
   53 AZ = FZ1U * A(I,J,KMX) + FZ2U * A(I,J,KMM) + FZ3U * A(I,J,KMMM)
   55 IF ( IDX ) 60, 61, 62
```

```
60 AX = FX1D*A(3,J,K) + FX2D*A(2,J,K) + FX3D*A(1,J,K)
   GO TO 65
61 AX = FX1*A(IP,J,K) + FX2*A(I,J,K) + FX3*A(IM,J,K)
   GO TO 65
62 AX = FX1U*A(IMX,J,K) + FX2U*A(IMM,J,K) + FX3U*A(IMMM,J,K)
65 IF ( IDY ) 70, 71, 72
70 AY = FY1D*A(I,3,K) + FY2D*A(I,2,K) + FY3D*A(I,1,K)
   GO TO 75
71 AY = FY1*A(I,JP,K) + FY2*A(I,J,K) + FY3*A(I,JM,K)
   GO TO 75
72 AY = FY1U*A(I,JMX,K) + FY2U*A(I,JMM,K) + FY3U*A(I,JMMM,K)
75 U(I,J,K) = U(I,J,K) + ( AX - HX*AZ ) * 0.5
   V(I,J,K) = V(I,J,K) + ( AY - HY*AZ ) * 0.5
   W(I,J,K) = W(I,J,K) + AZ * 0.5
10 CONTINUE
   RETURN
   E   N   D
C
C
   SUBROUTINE PRINTS ( PYN, ID, U, V, W, H, AL, XX, YY, ZZ, UM, VM,
  &          WM, XM, YM, ZM, IC, JC, KC, SC, AKX, AKY, AKZ, ZK, IJKP )
   COMMON /INOUT/ II, IO, IOT, TDUMP, COMPC, PECHO, PINTER, PLAMBD,
  &               PUVW, PCONC, PLT /HEAD/ TITLE(20)
   COMMON /DIMENN/ IMX, JMX, KMX, IMM, JMM, KMM, IMMM, JMMM, KMMM,
  &                NM, MC, IJKX, JMIN, JITER, IJMX, MIJ, MIK, MJK
   COMMON /RGNS/ WT, POWER, IINTER, DUM3 /HVDISP/ CK, CKH, CKV
   COMMON /RELAXL/ OMEGAL, AGEMOL, EPSL, ITMAXL
   COMMON /RELAXC/ EPSC, ITMAXC, IDISP, ZLV, BCKGRD
   DIMENSION U(IMX,JMX,KMX), V(IMX,JMX,KMX), W(IMX,JMX,KMX),
  &          H(IMX,JMX), AL(IMX,JMX,KMX), XX(IMM), YY(JMM), ZK(KMX),
  &          ZZ(KMM), UM(NM), VM(NM), WM(NM), XM(NM), YM(NM),
  &          ZM(NM), IC(MC), JC(MC), KC(MC), SC(MC), IJKP(IJKX),
  &          AKX(IMX,JMX,KMX), AKY(IMX,JMX,KMX), AKZ(IMX,JMX,KMX),
  &          AT(3), VT(3), AC(2), AU(2,3), AP(2)
   DATA AU(1,1), AU(1,2), AU(1,3), AU(2,1), AU(2,2), AU(2,3) /
  &    3HEST, 3HIMA, 3HTED, 3HUPT, 3HIMI, 3HZED /, YES / 4HYES /
   DATA AT / 3HAKX,3HAKY,3HAKZ /, VT / 1HU,1HV,1HW /, AC / 1HL,1HC /
  &       , AP / 4H    ,4H PPM /
C
   IF ( PYN .NE. YES ) RETURN
   GO TO (1,2,3,2,3), ID
 1 WRITE(IO,100) TITLE, TDUMP, COMPC, PECHO, PINTER, PLAMBD,
  &              PUVW, PCONC, PLT
   IF ( TDUMP .EQ. YES ) GO TO 10
   WRITE(IO,101)
   GO TO 11
10 WRITE(IO,102) IOT
11 IF ( COMPC .NE. YES ) WRITE(IO,103)
   IF ( PINTER .NE. YES ) WRITE(IO,104)
   IF ( PLAMBD .NE. YES ) WRITE(IO,105)
   IF ( PUVW .EQ. YES ) GO TO 12
   WRITE(IO,147)
   IF ( COMPC .EQ. YES .OR. TDUMP .EQ. YES ) GO TO 13
   WRITE(IO,106)
   STOP
13 IF ( TDUMP .EQ. YES ) WRITE(IO,107) IOT
12 IF ( COMPC .EQ. YES ) GO TO 14
   IF ( PCONC .NE. YES ) GO TO 15
   WRITE(IO,108)
   GO TO 15
14 IF ( PCONC .EQ. YES .OR. PLT .EQ. YES ) GO TO 15
```

```
      IF ( TDUMP .EQ. YES ) GO TO 15
      WRITE(IO,130)
      STOP
   14 WRITE(IO,110) EOT
   15 IF ( PLT .EQ. YES ) WRITE(IO,145) ZLV
      WRITE(IO,127)
      WRITE(IO,111) IMX, JMX, KMX
C
      DO 17 I = 1, IJKX
      IJKP(I) = I + 1
   17 CONTINUE
      WRITE(IO,112)
      WRITE(IO,113) ( ( I, IJKP(I), XX(I) ), I = 1, IMX )
      WRITE(IO,114)
      WRITE(IO,113) ( ( I, IJKP(I), YY(I) ), I = 1, JMX )
      WRITE(IO,115)
      WRITE(IO,113) ( ( I, IJKP(I), ZZ(I) ), I = 1, KMX )
C
      JB = 1
      JE = JMIN
      WRITE(IO,127)
      WRITE(IO,116)
      DO 20 JN = 1, JITER
      WRITE(IO,117) JB, JE
      DO 21 I = 1, IMX
      WRITE(IO,118) I, ( H(I,J), J = JB, JE )
   21 CONTINUE
      JB = JB + 15
      JE = JE + 15
      IF ( JN .GE. JITER ) JE = JMX
   20 CONTINUE
C
      WRITE(IO,127)
      WRITE(IO,119) NM
      WRITE(IO,120) ((I,XM(I),YM(I),ZM(I),UM(I),VM(I),WM(I)),I=1,NM)
      WRITE(IO,127)
      WRITE(IO,121) IINTEP, WT, OMEGAL, EPSL, POWER, ITMAXL
      WRITE(IO,129)
C
      IF ( PCONC .NE. YES ) GO TO 29
      GO TO ( 25, 26, 27, 24 ), IDISP
   25 WRITE(IO,122) CK
      WRITE(IO,127)
      GO TO 28
   26 WRITE(IO,123) CKH, CKV
      WRITE(IO,127)
      GO TO 28
   27 WRITE(IO,142) CKH
      WRITE(IO,143) ( ( K, ZK(K), AKZ(1,1,K) ), K = 1, KMX )
      WRITE(IO,127)
      GO TO 28
   24 WRITE(IO,124)
      WRITE(IO,127)
      DO 30 IX = 1, 3
      DO 31 K = 1, KMX
      JB = 1
      JE = JMIN
      DO 32 JN = 1, JITER
      WRITE(IO,125) AT(IX), K, JB, JE, ZK(K)
      DO 33 I = 1, IMX
      IF ( IX-2 ) 41,42,43
```

```
   41 WRITE(IO,118) I, ( AKX(I,J,K), J=JB, JE )
      GO TO 33
   42 WRITE(IO,118) I, ( AKY(I,J,K), J=JB, JE )
      GO TO 33
   43 WRITE(IO,118) I, ( AKZ(I,J,K), J=JB, JE )
   33 CONTINUE
      JB = JB + 15
      JE = JE + 15
      IF ( JN .GE. JITER ) JE = JMX
   32 CONTINUE
   31 CONTINUE
      WRITE(IO,129)
   30 CONTINUE
   28 WRITE(IO,126) MC
      WRITE(IO,127) ( ( I, IC(I), JC(I), KC(I), SC(I) ), I = 1, MC )
      WRITE(IO,129)
      WRITE(IO,149) BCKGRD
      WRITE(IO,129)
      WRITE(IO,128) EPSC, ITMAXC
      WRITE(IO,129)
C
   29 IF ( TOJMP .NE. YES ) GO TO 50
      WRITE(IOT,130) TITLE
      WRITE(IOT,131) IMX, JMX, KMX
      WRITE(IOT,132) ( XX(I), I = 1, IMM )
      WRITE(IOT,132) ( YY(I), I = 1, JMM )
      WRITE(IOT,132) ( ZZ(I), I = 1, KMM )
      WRITE(IOT,132) ( ( H(I,J), I = 1, IMX ), J = 1, JMX )
      WRITE(IOT,133) WT, OMEGAL, EPSL, POWER, ITMAXL
      WRITE(IOT,131) NM
      WRITE(IOT,132) ( XM(I), I = 1, NM )
      WRITE(IOT,132) ( YM(I), I = 1, NM )
      WRITE(IOT,132) ( ZM(I), I = 1, NM )
      WRITE(IOT,132) ( UM(I), I = 1, NM )
      WRITE(IOT,132) ( VM(I), I = 1, NM )
      WRITE(IOT,132) ( WM(I), I = 1, NM )
      IF ( COMPC .NE. YES ) GO TO 50
      WRITE(IOT,131) MC
      WRITE(IOT,134) ( ( IC(I), JC(I), KC(I), SC(I) ), I = 1, MC )
      WRITE(IOT,131) IDISP
      GO TO ( 51, 52, 55, 53 ), IDISP
   51 WRITE(IOT,132) CK
      GO TO 54
   52 WRITE(IOT,132) CKH, CKV
      GO TO 54
   53 WRITE(IOT,132) CKH
      WRITE(IOT,132) ( AKZ(1,1,K), K = 1, KMX )
      GO TO 54
   55 WRITE(IOT,132)( ( (AKX(I,J,K),I=1,IMX),J=1,JMX),K=1,KMX )
      WRITE(IOT,132)( ( (AKY(I,J,K),I=1,IMX),J=1,JMX),K=1,KMX )
      WRITE(IOT,132)( ( (AKZ(I,J,K),I=1,IMX),J=1,JMX),K=1,KMX )
   54 WRITE(IOT,135) OMEGAC, EPSC, ITMAXC, BCKGRD
   50 RETURN
C
    2 IF ( DUMB .NE. 0.0 ) GO TO 60
      WRITE(IO,148)
      WRITE(IO,129)
      RETURN
   60 IF ( IO-3 ) 61, 61, 62
   61 WRITE(IO,136)
      IEO = 1
```

```
      IVELE = 4 - IINTEP
      GO TO 53
   52 WRITE(IO,137)
      IEN = 2
      IVELE = 3
   53 CONTINUE
      DO 70 IVEL = 1, IVELE
      DO 71 K = 1, KMX
      JB = 1
      JE = JMIN
      DO 72 JN = 1, JITER
      WRITE(IO,138) (AU(IFO,M),M=1,3), VT(IVEL), K, JB, JE, ZK(K)
      DO 73 I = 1, IMX
      IF ( IVEL-2 ) 81, 82, 83
   81 WRITE(IO,110) I, ( U(I,J,K), J = JB, JE )
      GO TO 73
   82 WRITE(IO,110) I, ( V(I,J,K), J = JB, JE )
      GO TO 73
   83 WRITE(IO,110) I, ( W(I,J,K), J = JB, JE )
   73 CONTINUE
      JB = JB + 15
      JE = JE + 15
      IF ( JN .GE. JITER ) JE = JMX
   72 CONTINUE
   71 CONTINUE
      WRITE(IO,120)
   70 CONTINUE
      IF ( IO .NE. 2 ) GO TO 74
      IF ( IINTEP .NE. 2 ) GO TO 74
      WRITE(IO,144)
      WRITE(IO,129)
   74 CONTINUE
C
      IF ( IDUMP .NE. YES ) RETURN
      IF ( IO .NE. 4 ) RETURN
      WRITE(IOT,132) ( ( ( U(I,J,K),I=1,IMX), J=1,JMX), K=1,KMX )
      WRITE(IOT,132) ( ( ( V(I,J,K),I=1,IMX), J=1,JMX), K=1,KMX )
      WRITE(IOT,132) ( ( ( W(I,J,K),I=1,IMX), J=1,JMX), K=1,KMX )
      RETURN
C
    3 IF ( IO-4 ) 95, 95, 96
   95 WRITE(IO,140)
      ITAC = 1
      GO TO 97
   96 IF ( COMPC .NE. YES ) RETURN
      WRITE(IO,141)
      ITAC = 2
      ZK(1) = ZZ(1) * 0.25
   97 CONTINUE
      DO 90 K = 1, KMX
      JB = 1
      JE = JMIN
      DO 91 JN = 1, JITER
      WRITE(IO,139) AC(ITAC), AP(ITAC), K, JB, JE, ZK(K)
      DO 92 I = 1, IMX
      WRITE(IO,146) I, ( AL(I,J,K), J = JB, JE )
   92 CONTINUE
      JB = JB + 15
      JE = JE + 15
      IF ( JN .GE. JITER ) JE = JMX
   91 CONTINUE
```

```
 90 CONTINUE
    WRITE(IO,129)
    IF ( ID .EQ. 3 ) RETURN
    IF ( TDUMP .NE. YES ) RETURN
    WRITE(IOT,132) ( ( ( AL(I,J,K),I=1,IMX), J=1,JMX), K=1,KMX )
    RETURN
100 FORMAT ( 1H1, //,55X,'*** MODEL VOWAQS ***',//,
   &                   5X,'A THREE-DIMENSIONAL VARIATIONALLY-OPTIMIZED',
   &                   ' WIND-FIELD AND AIR-QUALITY SIMULATION OVER AN',
   &                   ' ARBITRARILY-SHAPED TERRAIN',///,40X,20A4,//,
   &                   20X,'TDUMP  = ',A4,8X,'COMPC  = ',A4,8X,'PECHO ',
   &           ' = ',A4,  8X, 'PINTER = ',A4,/,20X,'PLAMBD = ',A4,8X,
   &          'PUVW   = ',A4,8X,'PCONC  = ',A4,8X,'PLT    = ',A4 )
101 FORMAT ( 1H0,/,20X,'TDUMP  = NO  .... TAPE(OR DISK) FILE OF ',
   &             'RESULTS WILL NOT BE CREATED.' )
102 FORMAT ( 1H0,19X,'RESULTS WILL BE STORED ON TAPE/DISK FILE NO.',
   &             I3,'.' )
103 FORMAT ( 1H0,19X,'COMPC  = NO  .... POLLUTANT CONCENTRATION ',
   &             'FIELD WILL NOT BE COMPUTED.' )
104 FORMAT ( 1H0,19X,'PINTER = NO  .... INTERPOLATED WIND-FIELD (INIT'
   &           ,'IAL ESTIMATE) WILL NOT BE PRINTED.' )
105 FORMAT ( 1H0,19X,'PLAMBD = NO  .... ADJOINT FUNCTION (SPACE-',
   &             'DEPENDENT LAGRANGEAN MULTIPLYERS) WILL NOT BE PRINTED.')
106 FORMAT ( 1H0,19X,'AT LEAST ONE OF PUVW, TDUMP, AND CCOMP MUST ',
   &             ' BE YES TO OBTAIN MEANINGFUL RESULTS.',/,20X,
   &             '********** RUN ABORTED **********.' )
107 FORMAT ( 1H0, 19X,'PUVW = NO  AND  TDUMP = YES .... WIND-FIELD ',
   &             'RESULT WILL NOT BE PRINTED',/,20X,'BUT WILL BE STORED',
   &             ' ON FILE NO.',I3,'.' )
108 FORMAT ( 1H0,19X,'PCONC  = YES  IS OVERRIODEN BY COMPC = NO .' )
109 FORMAT ( 1H0,9X,'PCONC = NO  AND PLT = NO, AND TDUMP = NO  ....',
   &             ' AT LEAST ONE OF THEM MUST BE YES.',/,
   &             10X,'********** RUN ABORTED. **********' )
110 FORMAT ( 1H0,19X,'PCONC = NO  AND  TDUMP = YES .... CONCENT',
   &             'RATION RESULT WILL NOT BE PRINTED',/,20X,'BUT WILL BE',
   &             ' STORED ON FILE NO.',I3,'.' )
111 FORMAT ( 1H0,/,20X,'SIZE OF THE GRID SYSTEM :   IMAX =',I3,',',
   &            5X,'JMAX =',I3,',',6X,'KMAX =',I3 )
112 FORMAT ( 1H0,/,20X,'DISTANCES BETWEEN I-NODES (METERS) :',/ )
113 FORMAT ( 100 ( 10X,4('(',I4,' TO',I3,' ):',F7.2,5X ),/ ) )
114 FORMAT ( 1H0,19X,'DISTANCES BETWEEN J-NODES (METERS) :',/ )
115 FORMAT ( 1H0,19X,'DISTANCES BETWEEN K-NODES (METERS) :',/ )
116 FORMAT ( 1H0,/,20X,'GROUND TOPOGRAPHY IN METERS HEIGHT FROM '
   &           'THE REFERENCE HEIGHT AT H(1,1) = 0.0 METERS',/ )
117 FORMAT ( 1H ,19X,'H(I,J) : J =',I3,' TO ',I3,/ )
118 FORMAT ( 2X,'I =',I3,': ',15F8.3 )
119 FORMAT ( 1H0,/,20X,'WIND SPEEDS ARE MEASURED AT',I3,' LOCATIONS',
   &            //,20X,'LOCATION NO.',5X,'X-ORD. ',5X,'Y-ORD. ',5X,
   &            'Z-ORD. ',8X,'U',10X,'V', 9X,'W',/ )
120 FORMAT ( 100(25X,I3,8X,F7.2,2(5X,F7.2),3(5X,F5.2),/) )
121 FORMAT ( 1H0,19X'WIND INTERPOLATION OPTION, IINTEP =',I2,' IS',
   &             ' CHOSEN',//,
   &                20X,'WEIGHTING FACTOR FOR WIND INTERPOLATION',
   &             ' (WEIGHT) =',E8.2,/,20X,'( IGNORED IF IINTEP = 2 )',//,
   &        20X,'OVER-RELAXATION FACTOR FOR LAMBDA (OMEGAL) =',F5.2,//,
   &        20X,'MAXIMUM ERROR TOLERANCE FOR SORLAM (EPSL) =',E8.2,//,
   &        20X,'EXPONENT OF THE WIND PROFILE POWER LAW (POWER) =',F5.3,
   &    /,20X,'( IGNORED IF IINTEP = 1 )',//,
   &        20X,'MAXIMUM SORLAM ITERATION (ITMAXL) =',I5 )
122 FORMAT ( 1H0,/,20X,'IDISP OPTION 1 IS CHOSEN ... DIFFUSIVITY',
   &             ' IS CONSTANT : CK = ',F7.3,/ )
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 123 FORMAT ( 1H0,/,20X,'IDISP OPTION [illegible] IS CHOSEN ... ',//,20X,
    &              'HORIZONTAL DIFFUSIVITY IS CONSTANT : CKH =',F7.3,//,
    &        20X,'VERTICAL DIFFUSIVITY IS CONSTANT : CKV =',F7.3 )
 124 FORMAT ( 1H0,/,20X,'IDISP OPTION 4 IS CHOSEN ... DIFFUSIVITY IS'
    &                         'IS FULLY SPACE-DEPENDENT :' )
 125 FORMAT ( 1H0,14X,A8,'(I,J,K) :     K =',I3,',   J =',I3,' TO ',I3,
    &              10X,F5.2,' METERS ABOVE THE GROUND',/ )
 126 FORMAT ( 1H0,/,20X,'NUMBER OF SOURCE LOCATIONS =',I3,//,20X,
    &              'LOCATION NO.    I-NODE    J-NODE    K-NODE          ',
    &              'SOURCE-STRENGTH',/ )
 127 FORMAT ( 1[illegible]X,I3,10X,I3,2(6X,I3),10X,E11.3,' CC/SEC.',/ ) )
 128 FORMAT ( 1H0,/,20X,'MAXIMUM ERROR TOLERANCE FOR SORCON (EPSC) =  '
    &             ,E9.2,//,20X,'MAXIMUM ITERATION FOR SORCON (ITMAXC)       ',
    &              '  =',I6 )
 129 FORMAT ( 1H0,1X,64('- ') )
 130 FORMAT ( 20A4 )
 131 FORMAT ( 10I[illegible] )
 132 FORMAT ( 10F8.3 )
 133 FORMAT ( 2F10.3,F10.3,I8 )
 134 FORMAT ( 3I10,F9.3 )
 135 FORMAT ( F10.4,I10,F3.4 )
 136 FORMAT ( 1H0,/,20X,'INTERPOLATED WIND-FIELD ... INITIAL ESTIMATE' )
 137 FORMAT ( 1H0,/,20X,'OPTIMIZED WIND-FIELD' )
 138 FORMAT ( 1H0,/,15X,3A3,2X,A1,'(I,J,K) AT K =',I3,',   J =',I3,
    &              ' TO ',I3,10X,F5.2,' METERS ABOVE THE GROUND',/ )
 139 FORMAT ( 1H0,/,15X,A1,'(I,J,K)',A4,' :   K =',I3,',   J =',I3,
    &              ' TO ',I3,5X,F6.2,' METERS ABOVE THE GROUND',/ )
 140 FORMAT ( 1H0,19X,'ADJOINT FUNCTION : LAMBDA(I,J,K)' )
 141 FORMAT ( 1H0,19X,'CONCENTRATION FIELD :  C(I,J,K)' )
 142 FORMAT ( 1H0,/20X,'IDISP OPTION 3 IS CHOSEN ... ',/,20X,
    &                        'HORIZONTAL DIFFUSIVITY IS CONSTANT : CKH =',
    &               F7.3,/,20X,'VERTICAL DIFFUSIVITY IS A FUNCTION OF ',
    &               'HEIGHT ABOVE THE GROUND :' )
 143 FORMAT ( 100( 20X,'K =',I3,5X,'HEIGHT =',F6.2,' METERS',5X,
    &              'CKV =',F7.3,/ ) )
 144 FORMAT ( 1H0,/,10X,'W(I,J,K) = 0.0 IS ASSUMED FOR THIS INTERPO',
    &              'LATION OPTION PENDIDING CORRECTION IN THE SUBSEQUENT',
    &             ' OPTIMIZATION.' )
 145 FORMAT ( 1H0,19X,'PLT      = YES .... HORIZONTAL CONCENTRATION ',
    &              'PLOT WILL BE ATTEMPTED FOR',F5.2,' METERS ABOVE ',
    &              'THE GROUND.' )
 146 FORMAT ( 2X,'I =',I3,': ',15F8.2 )
 147 FORMAT ( 1H0,19X,'PUVW    = NO   .... OPTIMIZED WIND FIELD WILL ',
    &              'NOT BE PRINTED.' )
 148 FORMAT ( 1H0,19X,'U, V, AND W ARE ZERO EVERYWHERE ....... ',
    &              'IT IS SILLY TO PRINT !!' )
 149 FORMAT ( 1H0,19X,'BACKGROUND CONCENTRATION, BCKGRD =',F8.4,
    &              ' PPM' )
      E N D
C
C
       SUBROUTINE SORCON ( U, V, W, H, CC, XX, YY, ZZ, IS, JS, KS, SS,
     &              J, AKX, AKY, AKZ, KOI, KOJ, ILEFTJ, ILEFTK, IRITEJ,
     &              IRITEK, JFRNTI, JFRNTK, JBACKI, JBACKK, HXI2M, HXMXM,
     &              HYI2M, HYMXM, ZZLP, ZZRP, ZZFR, ZZBK )
       INTEGER*2 KOI, KOJ, ILEFTJ, ILEFTK, IRITEJ, IRITEK, JFRNTI,
     &             JFRNTK, JBACKI, JBACKK
       COMMON /DIMSN/ IMX, JMX, KMX, IMM, JMM, KMM, IMMM, JMMM, KMMM,
     &          NM, NC, IJKX, JMIN, JITER, IJMX, MIJ, MIK, MJK
       COMMON /INOUT/ II, IO, IOT, D1,D2,D3,D4,D5,D6,D7,D8
       COMMON /HVDISP/ CK, CKH, CKV /NGWS/ DUM1, DUM2, IDUM, DUM3
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       COMMON /RELAXC/ EPS, ITMAX, IDISP, ZLEVEL, BCKGRD
       DIMENSION U(IMX,JMX,KMX), V(IMX,JMX,KMX), W(IMX,JMX,KMX),
      &          H(IMX,JMX), CC(IMX,JMX,KMX), XX(IMM), YY(JMM), ZZ(KMM),
      &          IS(MC), JS(MC), KS(MC), SC(MC), Q(IMX,JMX,KMX),
      &          AKX(IMX,JMX,KMX), AKY(IMX,JMX,KMX), AKZ(IMX,JMX,KMX),
      &          KJI(MIJ), KUJ(MIJ), ILEFTJ(MJK), ILEFTK(MJK),
      &          IRITEJ(MJK), IRITEK(MJK), JFRNTI(MIK), JFRNTK(MIK),
      &          JBACKI(MIK), JBACKK(MIK), HX12M(MJK), HXMXM(MJK),
      &          HY12M(MIK), HYMXM(MIK), ZZLR(MJK), ZZRR(MJK),
      &          ZZFR(MIK), ZZBR(MIK)
        IST = MAXO ( ITMAX-50, 20 )
C
        XRU = XX(IMM) / XX(IMMM)
        YRU = YY(JMM) / YY(JMMM)
        ZRU = ZZ(KMM) / ZZ(KMMM)
        XRD = XX(1) / XX(2)
        YRD = YY(1) / YY(2)
        XRD1 = XRD + 1.
        XRU1 = XRU + 1.
        YRD1 = YRD + 1.
        YRU1 = YRU + 1.
        ZRU1 = ZRU + 1.
        UG = 0.
        VG = 0.
        KOUNTX = 0
        KOUNTY = 0
        KOUNTZ = 0
        KUP = 0
        ILEFT = 0
        IRITE = 0
        JFRNT = 0
        JBACK = 0
        AXM = 0.0
        AYM = 0.0
        AZM = 0.0
        AXMI = 1.0E+10
        AYMI = 1.0E+10
        AZMI = 1.0E+10
        ZZ(1) = ZZ(1) * 0.75
        ZZ1R = 1. / ZZ(1)
        FZ1G = 0.4 * ZZ1R
        SZ1G = 1.2 * ZZ1R * ZZ1R
C
        DO 111 I = 1, IMX
        DO 111 J = 1, JMX
        DO 111 K = 1, KMX
        UG = UG + U(I.J,K)
        VG = VG + V(I,J,K)
        CC(I,J,K) = BCKGRD
        GO TO ( 91, 92, 93, 111 ), IDISP
   91   AKX(I,J,K) = CK
        AKY(I.J,K) = CK
        AKZ(I,J,K) = CK
        GO TO 111
   92   AKX(I,J,K) = CKH
        AKY(I,J,K) = CKH
        AKZ(I,J,K) = CKV
        GO TO 111
   93   AKX(I,J,K) = CKH
        AKY(I,J,K) = CKH
        AKZ(I,J,K) = AKZ(1,1,K)
```

```
  111 CONTINUE
C
      DO 9999 I = 1, IMX
      DO 9999 J = 1, JMX
      U(I,J,1) = U(I,J,2) * 0.25
      V(I,J,1) = V(I,J,2) * 0.25
      IF ( W(I,J,KMX) ) 9992, 9993, 9993
 9993 KUP = KUP + 1
      KUI(KUP) = I
      KUJ(KUP) = J
 9992 AKX(I,J,1) = 0.25 * AKX(I,J,2) + 0.75 * AKX(I,J,1)
      AKY(I,J,1) = 0.25 * AKY(I,J,2) + 0.75 * AKY(I,J,1)
      AKZ(I,J,1) = 0.25 * AKZ(I,J,2) + 0.75 * AKZ(I,J,1)
      IF ( W(I,J,2) ) 9991, 9999, 9999
 9991 W(I,J,1) = W(I,J,2) * 0.25 * ZZIR
 9999 CONTINUE
C
      DO 300 J = 1, JMX
      DO 300 K = 1, KMM
      IF ( U(1,J,K) ) 301, 301, 302
  301 ILEFT = ILEFT + 1
      ILEFTJ(ILEFT) = J
      ILEFTK(ILEFT) = K
      HX12M(ILEFT) = ( H(2,J)-H(1,J) )/XX(1) - ( H(3,J)-H(2,J) )/XX(2)
      ZZLR(ILEFT) = 1. / ZZ(K)
  302 IF ( U(IMX,J,K) ) 300, 303, 303
  303 IRITE = IRITE + 1
      IRITEJ(IRITE) = J
      IRITEK(IRITE) = K
      HXMXM(IRITE) = (H(IMX,J)-H(IMM,J))/XX(IMM) - (H(IMM,J)-H(IMMM,J))
     &                   / XX(IMMM)
      ZZRR(IRITE) = 1. / ZZ(K)
  300 CONTINUE
C
      DO 304 I = 1, IMX
      DO 304 K = 1, KMM
      IF ( V(I,1,K) ) 305, 305, 306
  305 JFRNT = JFRNT + 1
      JFRNTI(JFRNT) = I
      JFRNTK(JFRNT) = K
      HY12M(JFRNT) = ( H(I,2)-H(I,1) )/YY(1) - ( H(I,3)-H(I,2) )/YY(2)
      ZZFR(JFRNT) = 1. / ZZ(K)
  306 IF ( V(I,JMX,K) ) 304, 307, 307
  307 JBACK = JBACK + 1
      JBACKI(JBACK) = I
      JBACKK(JBACK) = K
      HYMXM(JBACK) = (H(I,JMX)-H(I,JMM))/YY(JMM) - (H(I,JMM)-H(I,JMMM))
     &                   / YY(JMMM)
      ZZBR(JBACK) = 1. / ZZ(K)
  304 CONTINUE
C
      DO 1 I = 1, IMX
      IM1 = I - 1
      IF ( IM1 ) 2, 3, 2
    2 IF ( I-IMX ) 4, 5, 4
    4 DX = ( XX(I) + XX(IM1) ) * 0.5
      GO TO 6
    3 DX = XX(1)
      GO TO 6
    5 DX = XX(IMM)
    6 CONTINUE
```

```
      DO 1 J = 1, JMX
      JM1 = J - 1
      IF ( JM1 ) 7, 8, 7
    7 IF ( J-JMX ) 9, 10, 9
    9 DY = ( YY(J) + YY(JM1) ) * 0.5
      GO TO 11
    8 DY = YY(1)
      GO TO 11
   10 DY = YY(JMM)
   11 CONTINUE
      DO 1 K = 1, KMX
      KM1 = K - 1
      IF ( KM1 ) 13, 13, 12
   12 IF ( K-KMX ) 14, 15, 14
   14 DZ = ( ZZ(K) + ZZ(KM1) ) * 0.5
      GO TO 16
   13 DZ = ZZ(1) * 0.33333
      GO TO 16
   15 DZ = ZZ(KMM)
   16 IF ( DUM3 .EQ. 0.0 ) GO TO 123
      DIFXN = ABS ( U(I,J,K) * DX * 0.55 )
      IF ( AKX(I,J,K) .GE. DIFXN ) GO TO 19
      KOUNTX = KOUNTX + 1
      AKX(I,J,K) = DIFXN
      IF ( AKX(I,J,K) .LE. AXM ) GO TO 19
      AXM = AKX(I,J,K)
      IKX = I
      JKX = J
      KKX = K
   19 IF ( AKX(I,J,K) .GE. AXMI ) GO TO 119
      AXMI = AKX(I,J,K)
      MIKX = I
      MJKX = J
      MKKX = K
  119 DIFYN = ABS ( V(I,J,K) * DY * 0.55 )
      IF ( AKY(I,J,K) .GE. DIFYN ) GO TO 20
      KOUNTY = KOUNTY + 1
      AKY(I,J,K) = DIFYN
      IF ( AKY(I,J,K) .LE. AYM ) GO TO 20
      AYM = AKY(I,J,K)
      IKY = I
      JKY = J
      KKY = K
   20 IF ( AKY(I,J,K) .GE. AYMI ) GO TO 120
      AYMI = AKY(I,J,K)
      MIKY = I
      MJKY = J
      MKKY = K
  120 DIFZN = ABS ( W(I,J,K) * DZ * 0.55 )
      IF ( AKZ(I,J,K) .GE. DIFZN ) GO TO 23
      KOUNTZ = KOUNTZ + 1
      AKZ(I,J,K) = DIFZN
      IF ( AKZ(I,J,K) .LE. AZM ) GO TO 23
      AZM = AKZ(I,J,K)
      IKZ = I
      JKZ = J
      KKZ = K
   23 IF ( AKZ(I,J,K) .GE. AZMI ) GO TO 123
      AZMI = AKZ(I,J,K)
      MIKZ = I
      MJKZ = J
```

```
      MKKZ = K
  123 CONTINUE
C
      DO 31 IMC = 1, MC
      IF ( I-IS(IMC) ) 35, 32, 35
   32 IF ( J-JS(IMC) ) 35, 33, 35
   33 IF ( K-KS(IMC) ) 35, 34, 35
   34 SCC       = SC(IMC) / ( DX * DY * DZ )
      Q(I,J,K) = SCC
      CC(I,J,K) = SCC + BCKGRD
      GO TO 31
   35 Q(I,J,K) = 0.0
   31 CONTINUE
    1 CONTINUE
C
      IF ( JUMB .EQ. 0. ) GO TO 124
      WRITE(IO,205) KOUNTX, AXM, IKX, JKX, KKX
      WRITE(IO,206) AXMI, MIKX, MJKX, MKKX
      WRITE(IO,207)
      WRITE(IO,208) KOUNTY, AYM, IKY, JKY, KKY
      WRITE(IO,209) AYMI, MIKY, MJKY, MKKY
      WRITE(IO,207)
      WRITE(IO,210) KOUNTZ, AZM, IKZ, JKZ, KKZ
      WRITE(IO,211) AZMI, MIKZ, MJKZ, MKKZ
      WRITE(IO,207)
  124 IMXP = IMX + 1
      JMXP = JMX + 1
C
      DO 999 IT = 1, ITMAX
      ERMAX = 0.0
C
      IF ( ILEFT .EQ. 0 ) GO TO 801
      DO 80 ILT = 1, ILEFT
      JL = ILEFTJ(ILT)
      KL = ILEFTK(ILT)
      DCDZ = ( CC(2,JL,KL+1) - CC(2,JL,KL) ) * ZZLR(ILT)
      CCILL =     XRO1      * CC(2,JL,KL) - XRO * CC(3,JL,KL) +
     &          HX12M(ILT) * DCDZ * XX(1)
      CC(1,JL,KL) = AMAX1 ( BCKGRD, CCILL )
   80 CONTINUE
C
  801 IF ( IRITE .EQ. 0 ) GO TO 802
      DO 81 IRE = 1, IRITE
      JR = IRITEJ(IRE)
      KR = IRITEK(IRE)
      DCDZ = ( CC(IMM,JR,KR+1) - CC(IMM,JR,KR) ) * ZZRR(IRE)
      CCMRR =     XRO1       * CC(IMM,JR,KR) - XRO * CC(IMMM,JR,KR)
     &          + DCDZ * HX1XM(IRE) * XX(IMM)
      CC(IMX,JR,KR) = AMAX1 ( BCKGRD, CCMRR )
   81 CONTINUE
C
  802 IF ( JFRNT .EQ. 0 ) GO TO 803
      DO 82 JFT = 1, JFRNT
      IF = JFRNTI(JFT)
      KF = JFRNTK(JFT)
      DCDZ = ( CC(IF,2,KF+1) - CC(IF,2,KF) ) * ZZFR(JFT)
      CCIFF =     YRO1       * CC(IF,2,KF) - YRO * CC(IF,3,KF)
     &        + HY12M(JFT) * DCDZ * YY(1)
      CC(IF,1,KF) = AMAX1 ( BCKGRD, CCIFF )
   82 CONTINUE
C
```

```
  803 IF( JBACK .EQ. 0 ) GO TO 804
      DO 83 JBK = 1, JBACK
      IB = JBACKI(JBK)
      KB = JBACKK(JBK)
      DCDZ = ( CC(IB,JMM,KB+1) - CC(IB,JMM,KB) ) * ZZBR(JBK)
      CCMBB =     YRU1       * CC(IB,JMM,KB) - YRU * CC(IB,JMMM,KB)
     &       + HYMXM(JBK) * DCDZ * YY(JMM)
      CC(IB,JMX,KB) = AMAX1 ( BCKGRD, CCMBB )
   83 CONTINUE
C
  804 IF ( KUP .EQ. 0 ) GO TO 805
      DO 84 KU = 1, KUP
      IKU = KUI(KU)
      JKU = KUJ(KU)
      CCIJKX =     ZRU1       * CC(IKU,JKU,KMM) - ZRU * CC(IKU,JKU,KMMM)
      CC(IKU,JKU,KMX) = AMAX1 ( BCKGRD, CCIJKX )
   84 CONTINUE
  805 CONTINUE
C
      DO 70 IX = 2, IMM
      IF ( UG ) 41, 42, 42
   41 I = IMXP - IX
      GO TO 43
   42 I = IX
   43 IP = I + 1
      IM = I - 1
      DX = XX(I)
      DXM = XX(IM)
      ALPHA = DXM / DX
      ALP1 = ALPHA + 1.
      DAP1 = DX * ALP1
      FX1 = ALPHA / DAP1
      FX2 = ( 1. - ALPHA ) / DXM
      FX3 = - ( FX1 + FX2 )
      SX1 = 2. / ( DX * DAP1 )
      SX2 = -2. / ( DX * DXM )
      SX3 = - ( SX1 + SX2 )
C
      DO 70 JX = 2, JMM
      IF ( VG ) 51, 52, 52
   51 J = JMXP - JX
      GO TO 53
   52 J = JX
   53 JP = J + 1
      JM = J - 1
      DY = YY(J)
      DYM = YY(JM)
      BETA = DYM / DY
      BET1 = BETA + 1.
      DBET1 = DY * BET1
      FY1 = BETA / DBET1
      FY2 = ( 1. - BETA ) / DYM
      FY3 = - ( FY1 + FY2 )
      SY1 = 2. / ( DY * DBET1 )
      SY2 = - 2. / ( DY * DYM )
      SY3 = - ( SY1 + SY2 )
      HIJ = H(I,J)
      HX = FX1 * H(IP,J) + FX2 *  HIJ   + FX3 * H(IM,J)
      HXX = SX1 * H(IP,J) + SX2 *  HIJ   + SX3 * H(IM,J)
      HY = FY1 * H(I,JP) + FY2 *  HIJ    + FY3 * H(I,JM)
      HYY = SY1 * H(I,JP) + SY2 *  HIJ    + SY3 * H(I,JM)
```

```
      HYSQ = HY * HY
      HXSQ = HX * HX
      HX2 = HX * 2.
      HY2 = HY * 2.
C
      DO 70 K = 1, KM1
      KM = K - 1
      DIFX = AKX(I,J,K)
      DIFY = AKY(I,J,K)
      DIFZ = AKZ(I,J,K)
      UIJK = U(I,J,K)
      VIJK = V(I,J,K)
      WIJK = W(I,J,K)
      CCPIJK = CC(I,J,K)
      AKXX = FX1*AKX(IP,J,K) + FX2*DIFX + FX3*AKX(IM,J,K)
      AKYY = FY1*AKY(I,JP,K) + FY2*DIFY + FY3*AKY(I,JM,K)
      D = DIFX * HYSQ + DIFY * HYSQ + DIFZ
      E = HX2 * DIFX
      F = HY2 * DIFY
      IF ( KM ) 63, 63, 64
   63 AKXZ = ( AKX(I,J,2) - AKX(I,J,1) ) * ZZ1R
      AKYZ = ( AKY(I,J,2) - AKY(I,J,1) ) * ZZ1R
      AKZZ = ( AKZ(I,J,2) - AKZ(I,J,1) ) * ZZ1R
      A = UIJK - AKXX + HX * AKXZ
      B = VIJK - AKYY + HY * AKYZ
      C = -UIJK*HX - VIJK*HY - HXSQ*AKXZ + HX*AKXX + DIFX*HXX
     &    -HYSQ*AKYZ + HY*AKYY + DIFY*HYY - AKZZ
      COW = C * FZ1G - D * SZ1G + WIJK
      EFZ1G = E * FZ1G
      FFZ1G = F * FZ1G
      AEFZ23 = A - EFZ1G
      BFFZ23 = B - FFZ1G
      DENOM = A*FX2 + B*FY2        - COW           - FX2*EFZ1G
     &       - FY2*FFZ1G   - DIFX*SX2 - DIFY*SY2
      CC(I,J,1) =   ( -(   FX1 * AEFZ23      - DIFX*SX1 ) * CC(IP,J,1)
     &                -(   FX3 * AEFZ23      - DIFX*SX3 ) * CC(IM,J,1)
     &                -(   FY1 * BFFZ23      - DIFY*SY1 ) * CC(I,JP,1)
     &                -(   FY3 * BFFZ23      - DIFY*SY3 ) * CC(I,JM,1)
     &                -           COW                    * CC(I,J,2)
     &                -  EFZ1G * ( FX1*CC(IP,J,2) + FX3*CC(IM,J,2) )
     &                -  FFZ1G * ( FY1*CC(I,JP,2) + FY3*CC(I,JM,2) )
     &                + Q(I,J,1) ) / DENOM
      GO TO 65
   64 KP = K + 1
      DZ = ZZ(K)
      DZM = ZZ(KM)
      GAMA = DZM / DZ
      GAM1 = GAMA + 1.
      DGAM1 = DZ * GAM1
      FZ1 = GAMA / DGAM1
      FZ2 = ( 1. - GAMA ) / DZM
      FZ3 = - ( FZ1 + FZ2 )
      SZ1 = 2. / ( DZ * DGAM1 )
      SZ2 = -2. / ( DZ * DZM )
      SZ3 = - ( SZ1 + SZ2 )
      AKXZ = FZ1*AKX(I,J,KP) + FZ2*    DIFX     + FZ3*AKX(I,J,KM)
      AKYZ = FZ1*AKY(I,J,KP) + FZ2*    DIFY     + FZ3*AKY(I,J,KM)
      AKZZ = FZ1*AKZ(I,J,KP) + FZ2*    DIFZ     + FZ3*AKZ(I,J,KM)
      C = WIJK - UIJK*HX - VIJK*HY - HXSQ*AKXZ + HX*AKXX + DIFX*HXX
     &     - HYSQ*AKYZ + HY*AKYY + DIFY*HYY - AKZZ
      EFZ1 = E * FZ1
```

```
      EFZ2 = E * FZ2
      EFZ3 = E * FZ3
      FFZ1 = F * FZ1
      FFZ2 = F * FZ2
      FFZ3 = F * FZ3
      AEFZ2 = UIJK - AKXX + HX*AKXZ + EFZ2
      BFFZ2 = VIJK - AKYY + HY*AKYZ + FFZ2
      DENOM = AEFZ2*FX2 + BFFZ2*FY2 + C*FZ2 - DIFX*SX2
     &       - DIFY*SY2 - D*SZ2
      CC(I,J,K) =    ( - (AEFZ2*FX1 - DIFX*SX1) * CC(IP,J,K)
     &                 - (BFFZ2*FY1 - DIFY*SY1) * CC(I,JP,K)
     &                 - (AEFZ2*FX3 - DIFX*SX3) * CC(IM,J,K)
     &                 - (BFFZ2*FY3 - DIFY*SY3) * CC(I,JM,K)
     &                 - (C*FZ1-D*SZ1+EFZ1*FX2+FFZ1*FY2) * CC(I,J,KP)
     &                 - (C*FZ3-D*SZ3+EFZ3*FX2+FFZ3*FY2) * CC(I,J,KM)
     &                 - EFZ1 * ( FX1*CC(IP,J,KP) + FX3*CC(IM,J,KP) )
     &                 - EFZ3 * ( FX1*CC(IP,J,KM) + FX3*CC(IM,J,KM) )
     &                 - FFZ1 * ( FY1*CC(I,JP,KP) + FY3*CC(I,JM,KP) )
     &                 - FFZ3 * ( FY1*CC(I,JP,KM) + FY3*CC(I,JM,KM) )
     &                 + Q(I,J,K) ) / DENOM
C
   55 IF ( IT-IST ) 70, 50, 50
   50 ERROR = ABS ( CC(I,J,K) / CCPIJK - 1. )
      IF ( ERROR-ERMAX ) 70, 70, 55
   55 ERMAX = ERROR
   70 CONTINUE
C
      IF ( IT-IST ) 999, 98, 99
   98 WRITE(IO,203)
   99 WRITE(IO,204) IT, ERMAX
      IF ( ERMAX-EPS ) 100, 100, 999
  999 CONTINUE
C
      ERATIO = ERMAX / EPS
      WRITE(IO,205) IT, ERATIO
      WRITE(IO,207)
      RETURN
  100 WRITE(IO,206)
      WRITE(IO,207)
      RETURN
  200 FORMAT ( 2X,'X-COMPONENT INSTABILITIES HAVE BEEN DETECTED AT ',
     &        I6,' LOCATIONS. LOCAL DIFFUSIVITIES HAVE BEEN ',
     &        'ADJUSTED ACCORDINGLY.',//,2X,'MAXIMUM X-COMPONENT ',
     &        'DIFFUSIVITY REQUIRED IS ',G9.3,' M**2/SEC. AT I =',I3,
     &        ', J =',I3,', K =',I3 )
  201 FORMAT ( 2X,'Y-COMPONENT INSTABILITIES HAVE BEEN DETECTED AT ',
     &        I6,' LOCATIONS. LOCAL DIFFUSIVITIES HAVE BEEN ',
     &        'ADJUSTED ACCORDINGLY.',//,2X,'MAXIMUM Y-COMPONENT ',
     &        'DIFFUSIVITY REQUIRED IS ',G9.3,' M**2/SEC. AT I =',I3,
     &        ', J =',I3,', K =',I3 )
  202 FORMAT ( 2X,'Z-COMPONENT INSTABILITIES HAVE BEEN DETECTED AT ',
     &        I6,' LOCATIONS. LOCAL DIFFUSIVITIES HAVE BEEN ',
     &        'ADJUSTED ACCORDINGLY.',//,2X,'MAXIMUM Z-COMPONENT ',
     &        'DIFFUSIVITY REQUIRED IS ',G9.3,' M**2/SEC. AT I =',I3,
     &        ', J =',I3,', K =',I3 )
  203 FORMAT ( 1H0,/  ,20X,'CONVERGENCE TREND OF CONC.-SOR',//,20X,
     &        'ITERATION NO.',12X,'RELATIVE ERROR' )
  204 FORMAT ( 24X,I4,17X,F11.7 )
  205 FORMAT ( 1H0,9X,'NO CONVERGENCE AT ',I3,' ITERATIONS WITH ',
     &        'MAX. ERROR/EPS = ',F10.3 )
  206 FORMAT ( 1H0,19X,'CONC.-SOR CONVERGED !!' )
```

```
  207 FORMAT ( 1H0,1X,64('-') )
  208 FORMAT ( /,2X,'MINIMUM X-COMPONENT DIFFUSIVITY ENCOUNTERED IS ',
     &            G9.3,' M**2/SEC. AT I =',I3,', J =',I3,', K =',I3 )
  209 FORMAT ( /,2X,'MINIMUM Y-COMPONENT DIFFUSIVITY ENCOUNTERED IS ',
     &            G9.3,' M**2/SEC. AT I =',I3,', J =',I3,', K =',I3 )
  210 FORMAT ( /,2X,'MINIMUM Z-COMPONENT DIFFUSIVITY ENCOUNTERED IS ',
     &            G9.3,' M**2/SEC. AT I =',I3,', J =',I3,', K =',I3 )
      E N D
C
C
      SUBROUTINE PLOTTR ( C, IHOR, IVER, XX, YY, ZZ, A )
      INTEGER*2 M, UCHAR, DCHAR, DIR, IBLANK
      COMMON /DIMENN/ IMX, JMX, KMX, IM, JM, KM, IMM, JMM, KMM,
     &                MM, ML, IJKX, JMIN, JITER, IJMX, MIJ, MIK, MJK
      COMMON /INPUT/ II, IO, IOT, D1,D2,D3,D4,D5,D6,D7,D8
      COMMON /RELAXL/ DUM1,IDUM1,IDUM2, ZLV
      DIMENSION C(IMX,JMX,KMX), IHOR(IJMX), IVER(IJMX), XX(IM),
     &          YY(JM), ZZ(KM), A(IMX,JMX,KMX), DIR(2), M(120),
     &          UCHAR(10), DCHAR(11)
      DATA UCHAR / 1H-,1H+,1H=,1H",1H$,1HE,1H0,1H*,1H#,1HM /
      DATA DCHAR / 1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9,1H.,1H0 /
      DATA DIR / 1HI, 1HJ /, IBLANK / 1H  /
C
      ZT = 0.
      DO 1 K = 2, KMX
      ZT = ZT + ZZ(K-1)
      IF ( ZT-ZLV ) 1, 2, 3
    1 CONTINUE
      WRITE(IO,901) ZLV
      STOP
    2 CONTINUE
      DO 4 I = 1, IMX
      DO 4 J = 1, JMX
      A(I,J,1) = C(I,J,K)
      IF ( A(I,J,1) .LT. 0.0 ) A(I,J,1) = 0.0
    4 CONTINUE
      GO TO 6
    3 ZD = ( ZT - ZLV ) / ZZ(K-1)
      DO 5 I = 1, IMX
      DO 5 J = 1, JMX
      A(I,J,1) = ( C(I,J,K+1) - C(I,J,K) ) * ZD + C(I,J,K)
      IF ( A(I,J,1) .LT. 0.0 ) A(I,J,1) = 0.0
    5 CONTINUE
    6 CMAX = 0.0
      DO 7 I = 1, IMX
      DO 7 J = 1, JMX
      CONC = A(I,J,1)
      IF ( CONC .GT. CMAX ) CMAX = CONC
    7 CONTINUE
      IF ( CMAX .GT. 0.0 ) GO TO 8
      WRITE(IO,911)
      STOP
    8 XMAX = 0.0
      XMIN = 1000000.
      A(1,1,2) = 0.0
      YMAX = 0.0
      YMIN = 1000000.
      A(1,1,4) = 0.0
      DO 9 I = 2, IMX
      IM1 = I - 1
      IF ( XX(IM1) .LT. XMIN ) XMIN = XX(IM1)
```

```
      XMAX = XMAX + XX(IM1)
      A(I,1,2) = A(IM1,1,2) + XX(IM1)
    9 CONTINUE
      DO 10 J = 2, JMX
      JM1 = J - 1
      IF ( YY(JM1) .LT. YMIN ) YMIN = YY(JM1)
      YMAX = YMAX + YY(JM1)
      A(1,J,3) = A(1,JM1,3) + YY(JM1)
   10 CONTINUE
      XR = XMAX / XMIN
      YR = YMAX / YMIN
      IF ( XR - 120. ) 11, 11, 12
   12 IF ( YR - 120. ) 13, 13, 14
   14 WRITE(IO,92)
      STOP
   11 IDOWN = IFIX ( YR + 0.5 ) + 1
      HO = 1.
      IF ( XR .LE. 50. ) HO = 2.
      DO 20 I = 2, IMX
      IHOR(I) = IFIX ( ( HO * A(I,1,2) / XMIN ) + 0.5 ) + 1
   20 CONTINUE
      DO 21 I = 2, JMX
      IVER(I) = IFIX ( ( A(1,I,3)/YMIN )   + 0.5 ) + 1
   21 CONTINUE
      IJMAX = IMX
      JIMAX = JMX
      IGD = 1
      GO TO 15
   13 IDOWN = IFIX ( XR + 0.5 ) + 1
      HO = 1.
      IF ( YR .LE. 50. ) HO = 2.
      DO 22 I = 2, JMX
      IHOR(I) = IFIX ( ( HO * A(1,I,3) / YMIN ) + 0.5 ) + 1
   22 CONTINUE
      DO 23 I = 2, IMX
      IVER(I) = IFIX ( ( A(I,1,2)/XMIN ) + 0.5 ) + 1
   23 CONTINUE
      IJMAX = JMX
      JIMAX = IMX
      IGD = 2
   15 IDG = 3 - IGD
      IHOR(1) = 1
      IVER(1) = 1
      WRITE(IO,100) ZLV
      WRITE(IO,101) DIR(IGD), DIR(IGD), IJMAX
      ICOUNT = 0
      DO 50 IV = 1, IDOWN
      DO 30 MB = 1, 120
      M(MB) = IBLANK
   30 CONTINUE
      DO 31 ITATE = 1, JIMAX
      IF ( IV .EQ. IVER(ITATE) ) GO TO 40
   31 CONTINUE
      WRITE(IO,102) M
      GO TO 50
   40 ICOUNT = ICOUNT + 1
      DO 45 IYOKO = 1, IJMAX
      MM = IHOR(IYOKO)
      IF ( IGD-1 ) 50, 41, 42
   41 AR = A(IYOKO,ITATE,1)
      GO TO 43
```

```
   42 AR = A(ITATE,IYOKJ,1)
   43 AR = AR / CMAX
      IF ( AR .LT. 0.095 ) GO TO 46
      IM = IFIX ( ( AR + 0.05 ) * 10. )
      M(MM) = DCHAR(IM)
      GO TO 45
   46 IF ( AR .NE. 0.0 ) GO TO 47
      M(MM) = DCHAR(11)
      GO TO 45
   47 IM = IFIX ( ( AR + 0.005) * 100. )
      IF ( IM .NE. 0 ) GO TO 48
      M(MM) = DCHAR(10)
      GO TO 45
   48 M(MM) = DCHAR(14)
   45 CONTINUE
      WRITE(IO,103) DIR(IDG), ICOUNT, M
   50 CONTINUE
      WRITE(IO,104)
      DO 60 IX = 1, 10
      I = 11 - IX
      IF ( I .EQ. 10 ) GO TO 61
      IPC = I * 10
      WRITE(IO,105) DCHAR(I), IPC
      GO TO 60
   61 WRITE(IO,106) DCHAR(10), CMAX
   60 CONTINUE
      DO 70 IX = 1, 9
      I = 10 - IX
      WRITE(IO,105) DCHAR(I), I
   70 CONTINUE
      WRITE(IO,107) DCHAR(10)
      WRITE(IO,108) DCHAR(11)
      WRITE(IO,109)
      RETURN
  100 FORMAT ( 1H0,//,10X,'**** HORIZONTAL CONCENTRATION PROFILE AT ',
     &             F5.2,' METERS ABOVE THE GROUND SURFACE ****',// )
  101 FORMAT ( 10X,A1,' = 1   F)   ',A1,' =',I3,'  -------->',// )
  102 FORMAT ( 10X,120A1 )
  103 FORMAT ( 1X,A1,'=',I2,5X,120A1 )
  104 FORMAT ( //,10X,5('* '),' LEGEND ',5('* '),/ )
  105 FORMAT ( 10X,A1,' : ',I2,' % OF MAX. CONC.' )
  106 FORMAT ( 10X,A1,' : MAX. CONC. = ',G10.3,' PPM' )
  107 FORMAT ( 10X,A1,' : LESS THAN 1 % OF MAX. CONC.' )
  108 FORMAT ( 10X,A1,' : ABSOLUTE ZERO CONCENTRATION' )
  109 FORMAT ( //,10X,'NOTE .... X - Y COORDINATE SCALE IS DISTORTED ',
     &             ' IN THIS PLOT.' )
   90 FORMAT ( ///,11X,'ZLEVEL =',F5.2,' METERS  IS OUT OF THE DEFINED'
     &            ,' VERTICAL DOMAIN .... UNABLE TO PLOT.' )
   91 FORMAT ( ///,11X,'CONCENTRATION IS ZERO EVERYWHERE AT THIS ',
     &             ' HEIGHT .... PLOT ATTEMPT CANCELLED.' )
   92 FORMAT ( ///,11X,'PLOT IS NOT POSSIBLE WITH PROPER SCALING',
     &             ' .... ATTEMPT CANCELLED.' )
        E   N   D
/*
// EXEC LNKEDT
/*
/&
* $$ EOJ
```

} IBM JCL

APPENDIX B

EXAMPLE INPUT

```
* $$ JOB JNM=TEST07,CLASS=3,DISP=D,PRI=6,USER='WERIUDG'
* $$ LST CLASS=A,DISP=D,REMOTE=002,COPY=2,RBS=100
// JOB TEST07
// EXEC PROC=USRCL2
// EXEC VOWAQS
```

IBM JCL

```
*********  FINAL TEST RUN,  NO. 1  **********
NO  YES YES NO  NO  YES YES YES
      15      15      10
    100.    100.    100.    100.    100.     75.     50.     25.     20.     20.
     50.     75.    100.    100.    100.
    100.    100.    100.    100.    100.     75.     50.     25.     20.     20.
     50.     75.    100.    100.    100.
      .5      .5      .5      1.      5.     10.     10.     10.     10.     10.
      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
      0.      0.      0.      0.      0.      0.      .2      .5      .7      .9
      1.     1.1     1.1     1.1      1.      .9      .7      .5      .2      0.
      0.      .5      .9     1.4     1.7     2.0     2.1     2.2     2.1     2.0
     1.7     1.4      .9      .5      0.      .0      .7     1.4     1.9     2.4
     2.8     3.0     3.1     3.0     2.8     2.4     1.9     1.4     0.7     0.0
      0.     0.9     1.7     2.4     3.1     3.5     3.9     3.9     3.8     3.5
     3.1     2.4     1.7     0.9     0.0     0.0     1.1     2.1     3.0     3.8
     4.4     4.8     4.9     4.8     4.4     3.8     3.0     2.1     1.1     0.0
     0.0     1.1     2.2     3.1     3.9     4.5     4.9     5.0     4.9     4.5
     3.9     3.1     2.2     1.1     0.0     0.0     1.1     2.1     3.0     3.8
     4.4     4.8     4.9     4.8     4.4     3.5     3.0     2.1     1.1     0.0
     0.0     1.0     2.0     2.8     3.5     4.1     4.4     4.5     4.4     4.1
     3.5     2.8     2.0     1.0     0.0     0.0     0.9     1.7     2.4     3.1
     3.5     3.8     3.9     3.8     3.5     3.1     2.4     1.7     0.9     0.0
     0.0     0.7     1.4     1.9     2.4     2.8     3.0     3.1     3.0     2.8
     2.4     1.9     1.4     0.7     0.0     0.0     0.5     0.9     1.4     1.7
     2.0     2.1     2.2     2.1     2.0     1.7     1.4     0.9     0.5     0.0
     0.0     0.2     0.5     0.7     0.9     1.0     1.1     1.1     1.1     1.0
     0.9     0.7     0.5     0.2     0.0     0.0     0.0     0.0     0.0     0.0
     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
     0.0     0.0     0.0     0.0     0.0
       5
     10.     10.      1.      3.      1.      0.
    950.    900.     1.5     1.5     3.2      0.
     30.    800.      3.     3.2     1.8      0.
    120.    100.      8.     4.0     2.0     0.1
    750.      2.     10.     4.2     2.0    -0.1
       2     .01    1.85   0.001    0.20     250
       1
       4       5       2  10000.
   0.001     350       2     1.5    0.05
   100.0     1.0
```

```
/*
/&
* $$ EOJ
```

IBM JCL

APPENDIX C

```
                                            *** MODEL VOWAQS ***

A THREE-DIMENSIONAL VARIATIONALLY-OPTIMIZED WIND-FIELD AND AIR-QUALITY SIMULATION OVER AN ARBITRARILY-SHAPED TERRAIN

                                  ********* FINAL TEST RUN.  NO. 1  *********

          TDUMP  = NO          COMPC  = YES         PECHO  = YES         PINTER = NO
          PLAMBD = NO          PUVW   = YES         PCONC  = YES         PLT    = YES

          TDUMP  = NO  .... TAPE(OR DISK) FILE OF RESULTS WILL NOT BE CREATED.

          PINTER = NO  .... INTERPOLATED WIND-FIELD (INITIAL ESTIMATE) WILL NOT BE PRINTED.

          PLAMBD = NO  .... ADJOINT FUNCTION (SPACE-DEPENDENT LAGRANGEAN MULTIPLYERS) WILL NOT BE PRINTED.

          PLT    = YES .... HORIZONTAL CONCENTRATION PLOT WILL BE ATTEMPTED FOR 1.50 METERS ABOVE THE GROUND.
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

          SIZE OF THE GRID SYSTEM :   IMAX = 15,      JMAX = 15,      KMAX = 10

          DISTANCES BETWEEN I-NODES (METERS) :

(   1 TO  2 ): 100.00     (   2 TO  3 ): 100.00     (   3 TO  4 ): 100.00     (   4 TO  5 ): 100.00
(   5 TO  6 ): 100.00     (   6 TO  7 ):  75.00     (   7 TO  8 ):  50.00     (   8 TO  9 ):  25.00
(   9 TO 10 ):  20.00     (  10 TO 11 ):  20.00     (  11 TO 12 ):  50.00     (  12 TO 13 ):  75.00
(  13 TO 14 ): 100.00     (  14 TO 15 ): 100.00     (

          DISTANCES BETWEEN J-NODES (METERS) :

(   1 TO  2 ): 100.00     (   2 TO  3 ): 100.00     (   3 TO  4 ): 100.00     (   4 TO  5 ): 100.00
(   5 TO  6 ): 100.00     (   6 TO  7 ):  75.00     (   7 TO  8 ):  50.00     (   8 TO  9 ):  25.00
(   9 TO 10 ):  20.00     (  10 TO 11 ):  20.00     (  11 TO 12 ):  50.00     (  12 TO 13 ):  75.00
(  13 TO 14 ): 100.00     (  14 TO 15 ): 100.00     (

          DISTANCES BETWEEN K-NODES (METERS) :

(   1 TO  2 ):   0.50     (   2 TO  3 ):   0.50     (   3 TO  4 ):   0.60     (   4 TO  5 ):   1.00
(   5 TO  6 ):   5.00     (   6 TO  7 ):  10.00     (   7 TO  8 ):  10.00     (   8 TO  9 ):  10.00
(   9 TO 10 ):  10.00     (
```

EXAMPLE OUTPUT

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- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

              GROUND TOPOGRAPHY IN METERS HEIGHT FROM THE REFERENCE HEIGHT AT H(1,1) = 0.0 METERS

              H(I,J) : J =  1 TO  15

I =  1:   0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
I =  2:   0.0     0.200   0.500   0.700   0.900   1.100   1.100   1.100   1.000   0.900   0.700   0.500   0.200   0.0     0.0
I =  3:   0.0     0.500   0.900   1.400   1.700   2.100   2.200   2.100   2.000   1.700   1.400   0.900   0.500   0.0     0.0
I =  4:   0.0     0.700   1.400   1.900   2.400   3.000   3.100   3.000   2.800   2.400   1.900   1.400   0.700   0.0     0.0
I =  5:   0.0     0.900   1.700   2.400   3.100   3.800   3.900   3.800   3.500   3.100   2.400   1.700   0.900   0.0     0.0
I =  6:   0.0     1.000   2.000   2.800   3.500   4.400   4.500   4.400   4.100   3.500   2.800   2.000   1.000   0.0     0.0
I =  7:   0.0     1.100   2.100   3.000   3.800   4.900   4.900   4.800   4.400   3.800   3.000   2.100   1.100   0.0     0.0
I =  8:   0.0     1.100   2.200   3.100   3.900   4.900   5.000   4.900   4.500   3.900   3.100   2.200   1.100   0.0     0.0
I =  9:   0.0     1.100   2.100   3.000   3.800   4.800   4.900   4.800   4.400   3.800   3.000   2.100   1.100   0.0     0.0
I = 10:   0.0     1.000   2.000   2.800   3.500   4.400   4.500   4.400   4.100   3.500   2.800   2.000   1.000   0.0     0.0
I = 11:   0.0     0.900   1.700   2.400   3.100   3.800   3.900   3.300   3.500   3.100   2.400   1.700   0.900   0.0     0.0
I = 12:   0.0     0.700   1.400   1.900   2.400   3.000   3.100   3.000   2.800   2.400   1.900   1.400   0.700   0.0     0.0
I = 13:   0.0     0.500   0.900   1.400   1.700   2.100   2.200   2.100   2.000   1.700   1.400   0.900   0.500   0.0     0.0
I = 14:   0.0     0.200   0.500   0.700   0.900   1.100   1.100   1.100   1.000   0.900   0.700   0.500   0.200   0.0     0.0
I = 15:   0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

              WIND SPEEDS ARE MEASURED AT  5 LOCATIONS

              LOCATION NO.     X-ORD.       Y-ORD.       Z-ORD.        U          V          W

                    1           10.00        10.00         1.00        3.00       1.00       0.0
                    2          950.00       900.00         1.50        1.50       3.20       0.0
                    3           30.00       800.00         3.00        3.20       1.80       0.0
                    4          120.00       100.00         8.00        4.00       2.00       0.10
                    5          750.00         2.00        10.00        4.20       2.00      -0.10

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

              WIND INTERPOLATION OPTION, IINTEP = 2 IS CHOSEN

              WEIGHTING FACTOR FOR WIND INTERPOLATION (WEIGHT) =0.10E-01
              ( IGNORED IF IINTEP = 2 )

              OVER-RELAXATION FACTOR FOR LAMBDA (OMEGAL) = 1.85

              MAXIMUM ERROR TOLERANCE FOR SORLAM (EPSL) =0.10E-02

              EXPONENT OF THE WIND PROFILE POWER LAW (POWER) =0.200
              ( IGNORED IF IINTEP = 1 )

              MAXIMUM SORLAM ITERATION (ITMAXL) =  250
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- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

          IDISP OPTION 2 IS CHOSEN ...

          HORIZONTAL DIFFUSIVITY IS CONSTANT : CKH =100.000

          VERTICAL DIFFUSIVITY IS CONSTANT : CKV =  1.000

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

          NUMBER OF SOURCE LOCATIONS =  1

          LOCATION NO.   I-NODE   J-NODE   K-NODE          SOURCE-STRENGTH

               1            4        5        2            0.100E 05 CC/SEC.

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

          BACKGROUND CONCENTRATION, BCKGRD =  0.0500 PPM

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

          MAXIMUM ERROR TOLERANCE FOR SORCON (EPSC) = 0.10E-02

          MAXIMUM ITERATION FOR SORCON (ITMAXC)      = 350

          CONVERGENCE TREND OF LAMBDA-SOR

          ITERATION NO.            RELATIVE ERROR
               200                   0.0011091
               201                   0.0006223

      LAMBDA-SOR CONVERGED !!
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- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

          OPTIMIZED WIND-FIELD

               OPTIMIZED  U(I,J,K) AT K =  1,  J =  1 TO  15          0.0  METERS ABOVE THE GROUND

I =  1:     0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
I =  2:     0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
I =  3:     0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
I =  4:     0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
I =  5:     0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
I =  6:     0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
I =  7:     0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
I =  8:     0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
I =  9:     0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
I = 10:     0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
I = 11:     0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
I = 12:     0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
I = 13:     0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
I = 14:     0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
I = 15:     0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0

               OPTIMIZED  U(I,J,K) AT K =  2,  J =  1 TO  15          0.50 METERS ABOVE THE GROUND

I =  1:     2.609    2.467    2.359    2.343    2.305    2.255    2.223    2.215    2.214    2.217    2.220    2.224    2.231    2.232    2.211
I =  2:     2.456    2.302    2.333    2.340    2.307    2.261    2.236    2.228    2.228    2.229    2.230    2.230    2.231    2.222    2.198
I =  3:     2.381    2.332    2.339    2.331    2.296    2.255    2.232    2.224    2.224    2.223    2.222    2.216    2.210    2.190    2.153
I =  4:     2.363    2.340    2.331    2.309    2.272    2.230    2.203    2.192    2.188    2.186    2.183    2.169    2.154    2.125    2.096
I =  5:     2.336    2.323    2.308    2.280    2.238    2.188    2.152    2.132    2.124    2.118    2.109    2.087    2.056    2.017    1.990
I =  6:     2.308    2.302    2.284    2.251    2.199    2.134    2.081    2.048    2.032    2.019    2.004    1.965    1.916    1.865    1.844
I =  7:     2.299    2.298    2.282    2.243    2.179    2.097    2.025    1.975    1.949    1.929    1.906    1.854    1.786    1.726    1.714
I =  8:     2.300    2.308    2.291    2.250    2.181    2.090    2.000    1.934    1.897    1.869    1.839    1.771    1.691    1.626    1.623
I =  9:     2.302    2.312    2.298    2.255    2.177    2.082    1.982    1.906    1.866    1.829    1.796    1.725    1.640    1.575    1.577
I = 10:     2.303    2.308    2.294    2.242    2.154    2.047    1.941    1.850    1.816    1.778    1.751    1.681    1.593    1.534    1.541
I = 11:     2.305    2.302    2.277    2.214    2.121    1.997    1.886    1.804    1.758    1.724    1.699    1.631    1.547    1.496    1.535
I = 12:     2.307    2.296    2.251    2.176    2.073    1.925    1.801    1.710    1.665    1.631    1.596    1.532    1.452    1.405    1.423
I = 13:     2.303    2.289    2.243    2.159    2.036    1.873    1.729    1.627    1.575    1.535    1.499    1.423    1.334    1.295    1.325
I = 14:     2.282    2.259    2.201    2.103    1.961    1.777    1.620    1.513    1.460    1.419    1.384    1.310    1.236    1.217    1.257
I = 15:     2.245    2.212    2.139    2.021    1.869    1.678    1.526    1.426    1.380    1.345    1.314    1.263    1.213    1.221    1.260

               OPTIMIZED  U(I,J,K) AT K =  3,  J =  1 TO  15          1.00 METERS ABOVE THE GROUND

I =  1:     2.997    2.837    2.727    2.696    2.651    2.594    2.558    2.548    2.547    2.549    2.553    2.556    2.564    2.564    2.540
I =  2:     2.833    2.645    2.687    2.689    2.651    2.599    2.569    2.560    2.560    2.561    2.562    2.562    2.563    2.553    2.525
I =  3:     2.735    2.678    2.687    2.678    2.638    2.590    2.564    2.554    2.553    2.553    2.551    2.545    2.538    2.517    2.485
I =  4:     2.715    2.689    2.678    2.653    2.610    2.561    2.530    2.517    2.512    2.509    2.506    2.491    2.474    2.441    2.408
I =  5:     2.633    2.658    2.651    2.618    2.571    2.513    2.472    2.448    2.438    2.431    2.421    2.396    2.362    2.318    2.285
I =  6:     2.651    2.644    2.623    2.584    2.524    2.450    2.389    2.350    2.332    2.316    2.299    2.256    2.201    2.143    2.119
I =  7:     2.641    2.639    2.619    2.573    2.499    2.405    2.321    2.265    2.235    2.212    2.188    2.127    2.050    1.984    1.969
I =  8:     2.642    2.648    2.627    2.579    2.497    2.391    2.288    2.214    2.172    2.141    2.107    2.030    1.941    1.869    1.864
I =  9:     2.644    2.653    2.633    2.582    2.492    2.380    2.266    2.180    2.135    2.095    2.059    1.978    1.882    1.810    1.811
I = 10:     2.646    2.649    2.630    2.568    2.467    2.343    2.221    2.130    2.080    2.039    2.008    1.928    1.829    1.763    1.770
I = 11:     2.647    2.643    2.613    2.540    2.433    2.291    2.153    2.059    2.018    1.980    1.950    1.873    1.777    1.718    1.729
I = 12:     2.650    2.638    2.537    2.501    2.382    2.213    2.070    1.966    1.915    1.876    1.836    1.761    1.657    1.513    1.635
I = 13:     2.645    2.630    2.577    2.481    2.339    2.151    1.986    1.859    1.810    1.764    1.723    1.634    1.532    1.487    1.522
I = 14:     2.621    2.595    2.530    2.418    2.256    2.045    1.865    1.743    1.681    1.635    1.594    1.508    1.421    1.397    1.443
I = 15:     2.580    2.542    2.460    2.330    2.157    1.940    1.767    1.652    1.599    1.558    1.523    1.460    1.399    1.403    1.448
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            OPTIMIZED  J(I,J,K) AT K =  4,   J =  1 TO  15          1.60 METERS ABOVE THE GROUND

I =  1:   3.292  3.119  2.999  2.954  2.915  2.953  2.814  2.802  2.801  2.803  2.806  2.809  2.817  2.816  2.790
I =  2:   3.112  2.906  2.952  2.955  2.914  2.956  2.824  2.813  2.813  2.814  2.815  2.815  2.816  2.804  2.774
I =  3:   3.004  2.942  2.951  2.942  2.898  2.946  2.816  2.806  2.804  2.804  2.802  2.795  2.798  2.765  2.737
I =  4:   2.992  2.954  2.942  2.914  2.857  2.813  2.780  2.754  2.757  2.755  2.751  2.735  2.717  2.683  2.645
I =  5:   2.947  2.931  2.912  2.876  2.824  2.751  2.715  2.590  2.678  2.669  2.659  2.632  2.595  2.547  2.611
I =  6:   2.913  2.904  2.881  2.838  2.772  2.690  2.623  2.580  2.562  2.543  2.524  2.477  2.417  2.355  2.327
I =  7:   2.902  2.898  2.875  2.824  2.743  2.639  2.547  2.495  2.452  2.427  2.411  2.335  2.252  2.177  2.153
I =  8:   2.902  2.908  2.883  2.828  2.738  2.620  2.507  2.425  2.381  2.347  2.311  2.229  2.131  2.053  2.049
I =  9:   2.904  2.912  2.889  2.831  2.731  2.607  2.432  2.393  2.339  2.295  2.257  2.170  2.056  1.939  1.990
I = 10:   2.906  2.939  2.885  2.817  2.705  2.568  2.434  2.335  2.282  2.237  2.203  2.117  2.009  1.937  1.944
I = 11:   2.908  2.903  2.958  2.789  2.671  2.514  2.374  2.272  2.216  2.175  2.147  2.057  1.952  1.887  1.900
I = 12:   2.911  2.898  2.843  2.748  2.617  2.432  2.275  2.161  2.105  2.062  2.019  1.935  1.831  1.772  1.796
I = 13:   2.935  2.887  2.831  2.725  2.569  2.363  2.182  2.053  1.989  1.938  1.993  1.795  1.583  1.633  1.572
I = 14:   2.879  2.852  2.780  2.658  2.480  2.249  2.052  1.917  1.851  1.800  1.754  1.659  1.562  1.534  1.536
I = 15:   2.835  2.793  2.705  2.554  2.376  2.140  1.959  1.824  1.756  1.721  1.682  1.611  1.541  1.541  1.591

            OPTIMIZED  J(I,J,K) AT K =  5,   J =  1 TO  15          2.60 METERS ABOVE THE GROUND

I =  1:   3.628  3.439  3.308  3.269  3.215  3.147  3.104  3.091  3.089  3.091  3.094  3.097  3.105  3.103  3.074
I =  2:   3.429  3.252  3.254  3.257  3.212  3.149  3.113  3.101  3.100  3.101  3.102  3.102  3.103  3.090  3.056
I =  3:   3.310  3.242  3.252  3.241  3.194  3.136  3.104  3.091  3.090  3.089  3.087  3.080  3.073  3.047  3.028
I =  4:   3.296  3.256  3.241  3.211  3.159  3.100  3.063  3.046  3.039  3.035  3.031  3.015  2.994  2.955  2.915
I =  5:   3.248  3.230  3.208  3.159  3.111  3.042  2.991  2.952  2.950  2.940  2.929  2.899  2.859  2.817  2.758
I =  6:   3.210  3.200  3.174  3.127  3.054  2.964  2.889  2.842  2.819  2.800  2.780  2.729  2.653  2.596  2.555
I =  7:   3.197  3.192  3.167  3.110  3.020  2.905  2.804  2.735  2.699  2.671  2.643  2.571  2.480  2.402  2.384
I =  8:   3.198  3.202  3.174  3.112  3.012  2.881  2.757  2.667  2.619  2.591  2.542  2.453  2.347  2.262  2.255
I =  9:   3.201  3.207  3.177  3.114  3.003  2.854  2.727  2.625  2.571  2.526  2.493  2.389  2.275  2.191  2.192
I = 10:   3.203  3.204  3.175  3.099  2.975  2.823  2.677  2.568  2.511  2.463  2.425  2.330  2.213  2.134  2.142
I = 11:   3.205  3.198  3.157  3.071  2.941  2.768  2.614  2.502  2.442  2.397  2.350  2.257  2.152  2.067  2.093
I = 12:   3.208  3.193  3.133  3.029  2.884  2.681  2.508  2.333  2.321  2.274  2.227  2.133  2.018  1.953  1.977
I = 13:   3.203  3.184  3.120  3.034  2.831  2.604  2.404  2.253  2.192  2.137  2.057  1.978  1.854  1.798  1.842
I = 14:   3.173  3.143  3.065  2.931  2.735  2.481  2.264  2.116  2.043  1.987  1.937  1.830  1.722  1.690  1.747
I = 15:   3.124  3.079  2.984  2.831  2.625  2.367  2.159  2.027  1.956  1.907  1.863  1.782  1.702  1.698  1.752

            OPTIMIZED  J(I,J,K) AT K =  6,   J =  1 TO  15          7.60 METERS ABOVE THE GROUND

I =  1:   4.495  4.268  4.109  4.050  3.992  3.908  3.857  3.840  3.836  3.837  3.839  3.842  3.849  3.844  3.810
I =  2:   4.250  3.970  4.036  4.040  3.983  3.905  3.861  3.846  3.844  3.844  3.844  3.845  3.846  3.830  3.788
I =  3:   4.102  4.017  4.029  4.017  3.959  3.887  3.846  3.830  3.827  3.825  3.823  3.816  3.808  3.777  3.728
I =  4:   4.073  4.036  4.017  3.979  3.915  3.841  3.794  3.772  3.764  3.757  3.753  3.734  3.710  3.665  3.613
I =  5:   4.025  4.004  3.976  3.927  3.855  3.758  3.705  3.669  3.652  3.639  3.626  3.591  3.543  3.490  3.437
I =  6:   3.978  3.954  3.932  3.873  3.783  3.670  3.577  3.518  3.489  3.465  3.440  3.379  3.299  3.219  3.178
I =  7:   3.962  3.954  3.920  3.847  3.736  3.592  3.467  3.381  3.337  3.302  3.267  3.181  3.072  2.977  2.954
I =  8:   3.954  3.953  3.924  3.844  3.717  3.551  3.399  3.288  3.230  3.185  3.139  3.033  2.905  2.854  2.796
I =  9:   3.956  3.957  3.929  3.842  3.702  3.525  3.354  3.233  3.159  3.116  3.066  2.953  2.815  2.715  2.717
I = 10:   3.959  3.956  3.924  3.827  3.674  3.480  3.301  3.159  3.101  3.045  2.997  2.833  2.741  2.645  2.655
I = 11:   3.971  3.952  3.909  3.800  3.639  3.424  3.235  3.078  3.026  2.972  2.924  2.808  2.657  2.578  2.594
I = 12:   3.976  3.957  3.885  3.757  3.575  3.325  3.111  2.958  2.882  2.823  2.765  2.645  2.501  2.414  2.453
I = 13:   3.967  3.946  3.857  3.723  3.509  3.226  2.979  2.835  2.718  2.650  2.569  2.451  2.296  2.227  2.283
I = 14:   3.932  3.896  3.801  3.637  3.396  3.082  2.816  2.631  2.541  2.472  2.407  2.274  2.136  2.093  2.155
I = 15:   3.871  3.818  3.705  3.522  3.272  2.955  2.699  2.529  2.440  2.388  2.333  2.226  2.119  2.105  2.172
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          OPTIMIZED  J(I,J,K) AT K =  7,  J =  1 TO  15          17.60 METERS ABOVE THE GROUND
I =  1:   5.219  5.056  4.971  4.912  4.732  4.634  4.574  4.552  4.547  4.546  4.546  4.548  4.555  4.547  4.537
I =  2:   5.027  4.697  4.777  4.732  4.715  4.624  4.571  4.552  4.548  4.548  4.549  4.549  4.550  4.530  4.497
I =  3:   4.953  4.752  4.756  4.751  4.683  4.598  4.548  4.529  4.524  4.522  4.519  4.513  4.504  4.468  4.417
I =  4:   4.817  4.776  4.751  4.707  4.631  4.543  4.487  4.460  4.449  4.442  4.435  4.416  4.388  4.335  4.273
I =  5:   4.751  4.736  4.702  4.644  4.559  4.456  4.331  4.336  4.316  4.301  4.285  4.245  4.190  4.117  4.057
I =  6:   4.705  4.688  4.649  4.578  4.472  4.338  4.228  4.156  4.121  4.092  4.054  3.994  3.901  3.807  3.757
I =  7:   4.687  4.674  4.631  4.544  4.411  4.240  4.091  3.989  3.937  3.897  3.856  3.757  3.631  3.522  3.434
I =  8:   4.689  4.681  4.632  4.532  4.379  4.178  3.998  3.870  3.834  3.752  3.700  3.579  3.432  3.317  3.308
I =  9:   4.692  4.635  4.633  4.525  4.358  4.142  3.944  3.802  3.729  3.670  3.614  3.484  3.327  3.213  3.214
I = 10:   4.695  4.685  4.629  4.511  4.330  4.097  3.886  3.734  3.656  3.594  3.538  3.404  3.241  3.130  3.141
I = 11:   4.698  4.683  4.618  4.488  4.297  4.043  3.820  3.660  3.579  3.516  3.457  3.321  3.156  3.050  3.059
I = 12:   4.703  4.681  4.598  4.447  4.230  3.937  3.634  3.504  3.415  3.346  3.278  3.131  2.959  2.851  2.901
I = 13:   4.695  4.658  4.575  4.404  4.151  3.816  3.524  3.319  3.217  3.139  3.064  2.899  2.716  2.632  2.701
I = 14:   4.651  4.610  4.500  4.307  4.023  3.653  3.337  3.121  3.016  2.935  2.850  2.697  2.530  2.474  2.551
I = 15:   4.579  4.519  4.391  4.181  3.890  3.521  3.219  3.019  2.925  2.853  2.787  2.652  2.518  2.490  2.559

          OPTIMIZED  J(I,J,K) AT K =  8,  J =  1 TO  15          27.60 METERS ABOVE THE GROUND
I =  1:   5.819  5.538  5.339  5.273  5.184  5.078  5.013  4.958  4.982  4.979  4.979  4.980  4.985  4.974  4.931
I =  2:   5.500  5.140  5.229  5.234  5.151  5.062  5.004  4.983  4.978  4.977  4.976  4.978  4.979  4.957  4.932
I =  3:   5.310  5.199  5.214  5.199  5.125  5.031  4.976  4.955  4.949  4.945  4.943  4.937  4.929  4.890  4.825
I =  4:   5.271  5.225  5.199  5.150  5.057  4.971  4.909  4.878  4.866  4.858  4.850  4.830  4.801  4.746  4.676
I =  5:   5.210  5.183  5.145  5.081  4.987  4.874  4.791  4.742  4.720  4.702  4.685  4.643  4.584  4.506  4.439
I =  6:   5.149  5.128  5.085  5.007  4.891  4.743  4.622  4.543  4.504  4.473  4.442  4.367  4.258  4.167  4.114
I =  7:   5.128  5.112  5.062  4.955  4.820  4.631  4.468  4.356  4.300  4.256  4.212  4.105  3.971  3.855  3.823
I =  8:   5.130  5.117  5.059  4.947  4.777  4.555  4.358  4.220  4.149  4.093  4.039  3.910  3.752  3.630  3.619
I =  9:   5.133  5.121  5.059  4.937  4.752  4.512  4.297  4.144  4.066  4.004  3.945  3.806  3.638  3.516  3.517
I = 10:   5.137  5.122  5.056  4.924  4.725  4.467  4.237  4.074  3.991  3.926  3.864  3.720  3.545  3.425  3.436
I = 11:   5.140  5.122  5.048  4.905  4.694  4.417  4.173  4.001  3.914  3.846  3.782  3.632  3.453  3.337  3.358
I = 12:   5.145  5.122  5.032  4.859  4.628  4.309  4.032  3.837  3.740  3.664  3.591  3.427  3.237  3.129  3.175
I = 13:   5.137  5.107  5.006  4.819  4.541  4.175  3.855  3.631  3.521  3.435  3.354  3.171  2.970  2.878  2.955
I = 14:   5.089  5.045  4.925  4.717  4.408  4.004  3.659  3.423  3.308  3.220  3.138  2.957  2.770  2.705  2.803
I = 15:   5.011  4.947  4.812  4.589  4.275  3.876  3.547  3.329  3.225  3.147  3.073  2.920  2.756  2.724  2.811

          OPTIMIZED  J(I,J,K) AT K =  9,  J =  1 TO  15          37.60 METERS ABOVE THE GROUND
I =  1:   6.190  5.998  5.689  5.616  5.520  5.407  5.340  5.313  5.306  5.302  5.301  5.301  5.304  5.290  5.246
I =  2:   5.951  5.468  5.564  5.571  5.493  5.388  5.326  5.303  5.297  5.295  5.294  5.296  5.297  5.273  5.215
I =  3:   5.648  5.530  5.545  5.530  5.452  5.353  5.294  5.270  5.263  5.259  5.256  5.252  5.242  5.203  5.133
I =  4:   5.607  5.561  5.530  5.478  5.390  5.288  5.221  5.138  5.175  5.166  5.157  5.137  5.108  5.050  4.974
I =  5:   5.542  5.514  5.472  5.404  5.304  5.184  5.096  5.042  5.018  4.999  4.981  4.937  4.876  4.795  4.722
I =  6:   5.477  5.454  5.407  5.324  5.200  5.043  4.914  4.828  4.787  4.754  4.721  4.643  4.539  4.434  4.375
I =  7:   5.456  5.435  5.380  5.276  5.120  4.918  4.745  4.626  4.566  4.519  4.473  4.362  4.222  4.102  4.057
I =  8:   5.457  5.439  5.374  5.252  5.058  4.830  4.621  4.475  4.402  4.344  4.287  4.153  3.988  3.852  3.850
I =  9:   5.451  5.443  5.372  5.239  5.041  4.782  4.554  4.393  4.313  4.249  4.187  4.043  3.867  3.740  3.741
I = 10:   5.454  5.445  5.370  5.227  5.014  4.737  4.494  4.322  4.237  4.169  4.104  3.952  3.759  3.644  3.656
I = 11:   5.458  5.447  5.365  5.212  4.987  4.691  4.432  4.250  4.159  4.089  4.020  3.861  3.672  3.549  3.572
I = 12:   5.474  5.449  5.354  5.179  4.923  4.584  4.239  4.032  3.980  3.900  3.822  3.646  3.442  3.327  3.377
I = 13:   5.455  5.434  5.326  5.127  4.830  4.440  4.099  3.852  3.745  3.654  3.567  3.372  3.157  3.059  3.144
I = 14:   5.414  5.368  5.244  5.023  4.695  4.267  3.900  3.650  3.528  3.435  3.346  3.151  2.949  2.875  2.981
I = 15:   5.330  5.265  5.127  4.897  4.558  4.150  3.802  3.571  3.460  3.376  3.297  3.127  2.954  2.897  2.990
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            OPTIMIZED  U(I,J,K) AT K = 10,  J =  1 TO  15          47.60 METERS ABOVE THE GROUND

I =  1:   5.487  5.191  5.975  5.894  5.799  5.673  5.604  5.576  5.568  5.563  5.561  5.550  5.551  5.544  5.499
I =  2:   6.134  5.732  5.835  5.842  5.760  5.650  5.585  5.561  5.555  5.552  5.551  5.553  5.554  5.528  5.457
I =  3:   5.921  5.777  5.812  5.797  5.716  5.612  5.549  5.524  5.516  5.512  5.509  5.505  5.496  5.456  5.391
I =  4:   5.378  5.831  5.797  5.743  5.651  5.543  5.473  5.437  5.423  5.413  5.404  5.385  5.355  5.296  5.214
I =  5:   5.910  5.780  5.735  5.654  5.559  5.433  5.340  5.284  5.258  5.238  5.219  5.174  5.112  5.030  4.950
I =  6:   5.741  5.716  5.656  5.578  5.448  5.283  5.147  5.057  5.013  4.978  4.945  4.864  4.755  4.650  4.597
I =  7:   5.719  5.695  5.634  5.524  5.359  5.147  4.965  4.840  4.778  4.729  4.682  4.558  4.424  4.301  4.254
I =  8:   5.721  5.697  5.625  5.494  5.309  5.047  4.929  4.677  4.602  4.542  4.484  4.346  4.178  4.047  4.036
I =  9:   5.725  5.701  5.523  5.460  5.269  4.995  4.751  4.591  4.508  4.443  4.380  4.251  4.051  3.922  3.922
I = 10:   5.728  5.704  5.621  5.458  5.244  4.951  4.697  4.517  4.431  4.352  4.295  4.138  3.949  3.820  3.832
I = 11:   5.732  5.709  5.617  5.457  5.220  4.908  4.638  4.449  4.354  4.282  4.210  4.044  3.948  3.720  3.744
I = 12:   5.738  5.712  5.613  5.430  5.150  4.904  4.495  4.277  4.172  4.088  4.007  3.920  3.606  3.436  3.540
I = 13:   5.729  5.697  5.585  5.374  5.062  4.652  4.294  4.046  3.924  3.829  3.738  3.531  3.305  3.202  3.295
I = 14:   5.675  5.529  5.502  5.272  4.930  4.482  4.098  3.836  3.709  3.611  3.519  3.310  3.073  3.010  3.125
I = 15:   5.538  5.523  5.384  5.152  4.815  4.383  4.020  3.779  3.652  3.574  3.439  3.303  3.111  3.036  3.135

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            OPTIMIZED  V(I,J,K) AT K =  1,  J =  1 TO  15          0.0  METERS ABOVE THE GROUND

I =  1:   0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
I =  2:   0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
I =  3:   0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
I =  4:   0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
I =  5:   0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
I =  6:   0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
I =  7:   0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
I =  8:   0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
I =  9:   0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
I = 10:   0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
I = 11:   0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
I = 12:   0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
I = 13:   0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
I = 14:   0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
I = 15:   0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0

            OPTIMIZED  V(I,J,K) AT K =  2,  J =  1 TO  15          0.50 METERS ABOVE THE GROUND

I =  1:   0.873  0.981  1.051  1.099  1.149  1.205  1.239  1.252  1.256  1.258  1.259  1.259  1.258  1.267  1.291
I =  2:   0.985  1.132  1.155  1.119  1.150  1.213  1.249  1.258  1.277  1.279  1.274  1.257  1.257  1.277  1.302
I =  3:   1.076  1.113  1.113  1.134  1.178  1.232  1.269  1.296  1.305  1.301  1.292  1.285  1.294  1.314  1.349
I =  4:   1.084  1.106  1.127  1.158  1.207  1.257  1.311  1.346  1.358  1.353  1.340  1.338  1.362  1.395  1.442
I =  5:   1.100  1.126  1.155  1.194  1.251  1.321  1.381  1.427  1.448  1.448  1.433  1.434  1.478  1.530  1.596
I =  6:   1.115  1.143  1.181  1.231  1.302  1.395  1.480  1.552  1.578  1.573  1.561  1.584  1.650  1.721  1.792
I =  7:   1.115  1.142  1.198  1.252  1.344  1.464  1.575  1.653  1.697  1.699  1.690  1.724  1.814  1.898  1.954
I =  8:   1.109  1.138  1.190  1.265  1.373  1.514  1.643  1.743  1.783  1.789  1.784  1.829  1.932  2.024  2.074
I =  9:   1.110  1.136  1.192  1.273  1.390  1.540  1.675  1.779  1.822  1.829  1.826  1.881  1.994  2.089  2.134
I = 10:   1.110  1.136  1.194  1.279  1.404  1.562  1.732  1.809  1.851  1.869  1.853  1.925  2.043  2.139  2.154
I = 11:   1.107  1.136  1.195  1.284  1.416  1.593  1.739  1.839  1.882  1.901  1.910  1.970  2.093  2.190  2.229
I = 12:   1.104  1.129  1.193  1.298  1.445  1.634  1.801  1.924  1.979  1.998  2.012  2.096  2.221  2.310  2.332
I = 13:   1.110  1.137  1.207  1.325  1.495  1.713  1.900  2.038  2.099  2.129  2.159  2.253  2.376  2.455  2.449
I = 14:   1.143  1.177  1.254  1.382  1.565  1.800  2.000  2.135  2.199  2.242  2.279  2.374  2.491  2.549  2.527
I = 15:   1.194  1.230  1.307  1.435  1.616  1.845  2.036  2.162  2.222  2.259  2.313  2.409  2.509  2.547  2.497
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```
          OPTIMIZED  V(I,J,K) AT K =  3,  J =  1 TO  15              1.00 METERS ABOVE THE GROUND

  I =  1:   1.003  1.127  1.219  1.252  1.320  1.385  1.423  1.438  1.443  1.445  1.445  1.446  1.446  1.455  1.482
  I =  2:   1.135  1.302  1.271  1.235  1.332  1.394  1.435  1.455  1.454  1.457  1.452  1.454  1.455  1.457  1.497
  I =  3:   1.236  1.280  1.280  1.303  1.353  1.415  1.457  1.485  1.495  1.491  1.483  1.477  1.486  1.503  1.550
  I =  4:   1.247  1.272  1.296  1.331  1.386  1.455  1.505  1.542  1.555  1.550  1.539  1.539  1.554  1.602  1.656
  I =  5:   1.257  1.295  1.328  1.372  1.437  1.517  1.534  1.634  1.657  1.653  1.646  1.650  1.699  1.757  1.820
  I =  6:   1.283  1.314  1.357  1.414  1.495  1.602  1.697  1.775  1.806  1.803  1.794  1.824  1.898  1.977  2.043
  I =  7:   1.283  1.312  1.354  1.438  1.543  1.681  1.806  1.903  1.942  1.947  1.943  1.986  2.087  2.180  2.240
  I =  8:   1.275  1.307  1.365  1.453  1.577  1.736  1.884  1.995  2.041  2.051  2.051  2.107  2.224  2.325  2.378
  I =  9:   1.275  1.304  1.357  1.452  1.595  1.768  1.923  2.038  2.087  2.099  2.101  2.158  2.295  2.399  2.447
  I = 10:   1.274  1.304  1.369  1.468  1.611  1.793  1.953  2.074  2.121  2.136  2.145  2.220  2.352  2.458  2.502
  I = 11:   1.272  1.302  1.370  1.473  1.625  1.817  1.985  2.108  2.159  2.183  2.198  2.272  2.410  2.517  2.554
  I = 12:   1.258  1.295  1.369  1.489  1.659  1.875  2.057  2.207  2.270  2.296  2.316  2.414  2.556  2.655  2.672
  I = 13:   1.274  1.304  1.385  1.521  1.716  1.966  2.182  2.338  2.408  2.445  2.483  2.594  2.734  2.821  2.808
  I = 14:   1.313  1.350  1.439  1.586  1.797  2.066  2.296  2.452  2.525  2.576  2.620  2.732  2.866  2.930  2.892
  I = 15:   1.371  1.413  1.501  1.649  1.856  2.120  2.338  2.483  2.553  2.606  2.657  2.767  2.882  2.926  2.868

          OPTIMIZED  V(I,J,K) AT K =  4,  J =  1 TO  15              1.60 METERS ABOVE THE GROUND

  I =  1:   1.102  1.238  1.339  1.387  1.450  1.522  1.563  1.580  1.585  1.587  1.589  1.589  1.588  1.595  1.629
  I =  2:   1.249  1.431  1.397  1.411  1.454  1.531  1.576  1.598  1.607  1.610  1.605  1.597  1.598  1.611  1.644
  I =  3:   1.359  1.407  1.406  1.431  1.436  1.555  1.601  1.630  1.640  1.636  1.628  1.622  1.632  1.658  1.703
  I =  4:   1.371  1.398  1.424  1.452  1.523  1.598  1.652  1.692  1.705  1.701  1.690  1.691  1.719  1.750  1.818
  I =  5:   1.394  1.423  1.459  1.507  1.578  1.666  1.739  1.792  1.816  1.819  1.808  1.815  1.857  1.930  1.997
  I =  6:   1.412  1.445  1.490  1.553  1.643  1.759  1.853  1.946  1.979  1.978  1.972  2.006  2.087  2.172  2.242
  I =  7:   1.411  1.442  1.498  1.580  1.695  1.846  1.982  2.036  2.128  2.137  2.135  2.185  2.295  2.395  2.457
  I =  8:   1.402  1.435  1.500  1.596  1.732  1.908  2.067  2.187  2.237  2.251  2.255  2.319  2.446  2.555  2.609
  I =  9:   1.401  1.432  1.501  1.605  1.753  1.941  2.110  2.235  2.289  2.305  2.311  2.387  2.524  2.636  2.684
  I = 10:   1.400  1.431  1.503  1.612  1.759  1.958  2.144  2.275  2.327  2.346  2.359  2.444  2.587  2.701  2.744
  I = 11:   1.397  1.429  1.504  1.618  1.785  1.995  2.179  2.313  2.369  2.398  2.417  2.502  2.651  2.765  2.801
  I = 12:   1.392  1.421  1.502  1.635  1.822  2.060  2.259  2.422  2.491  2.522  2.548  2.657  2.811  2.917  2.932
  I = 13:   1.409  1.432  1.520  1.670  1.885  2.159  2.396  2.567  2.644  2.688  2.730  2.854  3.007  3.100  3.081
  I = 14:   1.442  1.483  1.579  1.741  1.973  2.269  2.522  2.693  2.774  2.831  2.880  3.005  3.151  3.220  3.175
  I = 15:   1.506  1.552  1.649  1.810  2.039  2.329  2.569  2.729  2.805  2.863  2.918  3.040  3.166  3.215  3.151

          OPTIMIZED  V(I,J,K) AT K =  5,  J =  1 TO  15              2.60 METERS ABOVE THE GROUND

  I =  1:   1.214  1.364  1.476  1.529  1.598  1.677  1.723  1.741  1.747  1.749  1.751  1.751  1.750  1.762  1.795
  I =  2:   1.378  1.579  1.540  1.555  1.613  1.688  1.736  1.760  1.769  1.772  1.758  1.750  1.760  1.775  1.813
  I =  3:   1.497  1.551  1.551  1.578  1.638  1.713  1.763  1.794  1.804  1.801  1.793  1.788  1.798  1.827  1.877
  I =  4:   1.512  1.541  1.569  1.612  1.679  1.761  1.820  1.861  1.875  1.872  1.863  1.854  1.894  1.939  2.003
  I =  5:   1.538  1.569  1.608  1.651  1.739  1.835  1.914  1.971  1.997  2.001  1.992  2.002  2.059  2.127  2.199
  I =  6:   1.558  1.593  1.642  1.711  1.810  1.938  2.051  2.140  2.175  2.177  2.174  2.214  2.301  2.394  2.457
  I =  7:   1.556  1.589  1.651  1.741  1.858  2.033  2.181  2.293  2.340  2.352  2.354  2.412  2.531  2.640  2.734
  I =  8:   1.546  1.581  1.652  1.759  1.909  2.102  2.275  2.405  2.460  2.479  2.487  2.561  2.699  2.816  2.871
  I =  9:   1.544  1.577  1.653  1.758  1.931  2.138  2.323  2.459  2.518  2.538  2.550  2.637  2.735  2.906  2.954
  I = 10:   1.542  1.576  1.655  1.776  1.949  2.168  2.351  2.503  2.561  2.585  2.604  2.699  2.855  2.977  3.019
  I = 11:   1.539  1.573  1.555  1.782  1.956  2.197  2.400  2.546  2.609  2.642  2.667  2.763  2.925  3.048  3.082
  I = 12:   1.534  1.565  1.554  1.831  2.007  2.259  2.500  2.656  2.742  2.780  2.811  2.933  3.102  3.216  3.226
  I = 13:   1.542  1.577  1.674  1.839  2.076  2.379  2.640  2.827  2.912  2.963  3.011  3.149  3.317  3.417  3.392
  I = 14:   1.589  1.633  1.739  1.917  2.173  2.500  2.779  2.957  3.057  3.120  3.176  3.314  3.475  3.550  3.498
  I = 15:   1.650  1.710  1.817  1.995  2.247  2.566  2.831  3.006  3.091  3.155  3.216  3.350  3.489  3.543  3.472
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                  OPTIMIZED  V(I,J,K) AT K =  6,  J =  1 TO  15            7.60 METERS ABOVE THE GROUND

I =  1:     1.535    1.670    1.827    1.894    1.981    2.078    2.135    2.159    2.165    2.168    2.173    2.170    2.169    2.184    2.224
I =  2:     1.711    1.959    1.909    1.926    1.999    2.092    2.151    2.178    2.187    2.190    2.187    2.180    2.135    2.200    2.248
I =  3:     1.957    1.925    1.923    1.955    2.031    2.123    2.183    2.217    2.228    2.226    2.222    2.217    2.225    2.263    2.325
I =  4:     1.979    1.912    1.945    1.998    2.081    2.192    2.252    2.297    2.313    2.313    2.307    2.314    2.347    2.403    2.481
I =  5:     1.912    1.947    1.993    2.059    2.155    2.273    2.368    2.432    2.461    2.470    2.467    2.488    2.553    2.636    2.722
I =  6:     1.937    1.976    2.035    2.121    2.244    2.401    2.536    2.637    2.678    2.690    2.696    2.751    2.856    2.957    3.051
I =  7:     1.933    1.971    2.045    2.157    2.315    2.517    2.695    2.827    2.892    2.906    2.921    3.001    3.142    3.270    3.343
I =  8:     1.919    1.959    2.045    2.178    2.365    2.602    2.813    2.956    3.033    3.064    3.057    3.187    3.352    3.490    3.548
I =  9:     1.915    1.953    2.045    2.199    2.391    2.647    2.873    3.035    3.136    3.142    3.159    3.233    3.451    3.603    3.650
I = 10:     1.911    1.950    2.045    2.198    2.413    2.684    2.920    3.091    3.154    3.224    3.238    3.362    3.548    3.692    3.791
I = 11:     1.936    1.946    2.047    2.206    2.433    2.720    2.959    3.147    3.225    3.273    3.314    3.442    3.636    3.782    3.809
I = 12:     1.997    1.936    2.045    2.229    2.495    2.810    3.094    3.296    3.390    3.445    3.494    3.549    3.853    3.937    3.957
I = 13:     1.910    1.951    2.070    2.276    2.570    2.945    3.269    3.498    3.634    3.673    3.739    3.913    4.120    4.237    4.195
I = 14:     1.958    2.021    2.151    2.372    2.689    3.096    3.442    3.676    3.787    3.858    3.941    4.116    4.314    4.423    4.330
I = 15:     2.057    2.119    2.252    2.472    2.785    3.180    3.508    2.726    3.830    3.910    3.985    4.152    4.323    4.390    4.303

                  OPTIMIZED  V(I,J,K) AT K =  7,  J =  1 TO  15           17.60 METERS ABOVE THE GROUND

I =  1:     1.780    1.979    2.153    2.240    2.343    2.458    2.526    2.553    2.560    2.564    2.556    2.567    2.555    2.583    2.641
I =  2:     2.023    2.321    2.250    2.279    2.355    2.476    2.543    2.572    2.582    2.585    2.593    2.577    2.575    2.611    2.650
I =  3:     2.199    2.280    2.277    2.313    2.403    2.512    2.580    2.615    2.626    2.627    2.624    2.623    2.634    2.677    2.753
I =  4:     2.226    2.255    2.302    2.364    2.463    2.580    2.660    2.707    2.724    2.728    2.728    2.740    2.777    2.842    2.933
I =  5:     2.269    2.306    2.358    2.437    2.550    2.688    2.795    2.865    2.896    2.910    2.916    2.950    3.023    3.118    3.215
I =  6:     2.278    2.339    2.407    2.509    2.654    2.838    2.993    3.103    3.150    3.173    3.192    3.263    3.393    3.510    3.602
I =  7:     2.291    2.332    2.419    2.552    2.738    2.975    3.180    3.326    3.391    3.428    3.459    3.552    3.724    3.872    3.945
I =  8:     2.274    2.317    2.418    2.576    2.795    3.075    3.319    3.491    3.569    3.616    3.657    3.786    3.975    4.133    4.187
I =  9:     2.257    2.338    2.415    2.598    2.827    3.128    3.391    3.575    3.659    3.712    3.758    3.901    4.134    4.265    4.307
I = 10:     2.251    2.303    2.415    2.597    2.851    3.171    3.448    3.643    3.732    3.780    3.842    3.996    4.200    4.370    4.472
I = 11:     2.255    2.297    2.416    2.607    2.876    3.214    3.507    3.712    3.807    3.871    3.929    4.091    4.313    4.474    4.634
I = 12:     2.245    2.287    2.415    2.633    2.937    3.322    3.655    3.897    4.000    4.074    4.144    4.332    4.568    4.719    4.706
I = 13:     2.259    2.304    2.445    2.689    3.037    3.482    3.854    4.131    4.236    4.346    4.531    4.641    4.883    5.014    4.954
I = 14:     2.327    2.397    2.541    2.832    3.178    3.660    4.069    4.346    4.478    4.576    4.667    4.879    5.110    5.211    5.117
I = 15:     2.433    2.507    2.634    2.925    3.295    3.762    4.150    4.407    4.530    4.625    4.714    4.931    5.114    5.193    5.070

                  OPTIMIZED  V(I,J,K) AT K =  9,  J =  1 TO  15           27.60 METERS ABOVE THE GROUND

I =  1:     1.948    2.138    2.357    2.451    2.553    2.689    2.753    2.793    2.801    2.806    2.808    2.818    2.817    2.826    2.879
I =  2:     2.224    2.542    2.473    2.493    2.588    2.739    2.782    2.812    2.821    2.824    2.823    2.819    2.813    2.844    2.912
I =  3:     2.407    2.497    2.493    2.531    2.629    2.749    2.822    2.855    2.864    2.867    2.862    2.870    2.882    2.927    3.012
I =  4:     2.440    2.480    2.520    2.588    2.695    2.822    2.937    2.954    2.972    2.980    2.984    3.011    3.049    3.109    3.207
I =  5:     2.489    2.525    2.581    2.666    2.791    2.940    3.054    3.127    3.159    3.177    3.190    3.233    3.304    3.411    3.514
I =  6:     2.520    2.561    2.634    2.746    2.905    3.104    3.259    3.383    3.434    3.465    3.494    3.578    3.705    3.841    3.904
I =  7:     2.511    2.553    2.645    2.792    2.996    3.253    3.474    3.627    3.657    3.744    3.787    3.908    4.081    4.137    4.307
I =  8:     2.491    2.534    2.644    2.817    3.053    3.363    3.526    3.809    3.944    3.952    4.005    4.135    4.357    4.523    4.570
I =  9:     2.481    2.524    2.641    2.930    3.091    3.421    3.704    3.932    3.995    4.059    4.119    4.203    4.510    4.664    4.702
I = 10:     2.473    2.516    2.640    2.840    3.118    3.468    3.758    3.978    4.076    4.146    4.212    4.357    4.535    4.784    4.805
I = 11:     2.455    2.510    2.630    2.350    3.144    3.515    3.833    4.055    4.160    4.234    4.305    4.442    4.730    4.[illegible]    4.7[illegible]
I = 12:     2.455    2.499    2.640    2.878    3.211    3.633    3.997    4.250    4.372    4.453    4.54[illegible]    4.753    5.007    5.165    5.107
I = 13:     2.459    2.518    2.572    2.940    3.321    3.808    4.226    4.515    4.554    4.756    4.855    5.088    5.352    5.509    5.411
I = 14:     2.545    2.610    2.776    3.052    3.475    4.033    4.451    4.754    4.597    5.008    5.112    5.347    5.592    5.705    5.593
I = 15:     2.652    2.743    2.915    3.200    3.605    4.116    4.540    4.822    4.957    5.060    5.158    5.373    5.596    5.682    5.559
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          OPTIMIZED  V(I,J,K) AT K =  9,  J =  1 TO  15             37.50 METERS ABOVE THE GROUND

I =  1:   2.072   2.327   2.518   2.607   2.727   2.861   2.940   2.971   2.980   2.985   2.987   2.988   2.986   3.007   3.052
I =  2:   2.370   2.707   2.631   2.650   2.753   2.883   2.959   2.989   2.997   3.001   3.001   2.997   2.996   3.027   [illegible]
I =  3:   2.550   2.659   2.654   2.693   2.797   2.924   3.001   3.034   3.044   3.049   3.050   3.053   3.055   3.114   3.234
I =  4:   2.598   2.640   2.582   2.753   2.858   3.002   3.090   3.137   3.155   3.166   3.174   3.195   3.233   3.306   3.428
I =  5:   2.652   2.685   2.745   2.837   2.959   3.127   3.245   3.319   3.352   3.374   3.393   3.444   3.523   3.628   3.731
I =  6:   2.686   2.726   2.802   2.921   3.090   3.301   3.473   3.590   3.644   3.682   3.718   3.813   3.947   4.085   4.174
I =  7:   2.673   2.716   2.814   2.970   3.137   3.460   3.690   3.849   3.924   3.979   4.032   4.167   4.348   4.507   4.559
I =  8:   2.651   2.695   2.810   2.996   3.253   3.574   3.952   4.043   4.134   4.201   4.257   4.432   4.644   4.812   4.847
I =  9:   2.639   2.683   2.807   3.039   3.287   3.637   3.936   4.144   4.243   4.317   4.389   4.570   4.797   4.967   4.966
I = 10:   2.630   2.674   2.804   3.019   3.315   3.687   4.005   4.226   4.332   4.411   4.499   4.682   4.920   5.090   5.092
I = 11:   2.622   2.666   2.803   3.029   3.343   3.737   4.075   4.309   4.422   4.505   4.591   4.794   5.042   5.211   5.202
I = 12:   2.610   2.655   2.804   3.059   3.414   3.863   4.250   4.518   4.647   4.745   4.841   5.070   5.337   5.496   5.450
I = 13:   2.625   2.675   2.839   3.124   3.530   4.049   4.494   4.801   4.949   5.062   5.172   5.424   5.703   5.841   5.744
I = 14:   2.706   2.773   2.949   3.254   3.693   4.256   4.733   5.056   5.212   5.330   5.443   5.697   5.935   6.072   5.944
I = 15:   2.832   2.918   3.101   3.404   3.835   4.378   4.830   5.130   5.273   5.383   5.487   5.716   5.953   6.044   5.924

          OPTIMIZED  V(I,J,K) AT K = 10,  J =  1 TO  15             47.50 METERS ABOVE THE GROUND

I =  1:   2.172   2.440   2.640   2.733   2.859   2.999   3.082   3.115   3.124   3.129   3.131   3.132   3.130   3.152   3.210
I =  2:   2.489   2.342   2.758   2.776   2.886   3.023   3.103   3.132   3.140   3.143   3.144   3.141   3.139   3.172   3.250
I =  3:   2.691   2.789   2.784   2.823   2.932   3.065   3.145   3.177   3.187   3.193   3.196   3.201   3.212   3.263   3.358
I =  4:   2.726   2.770   2.912   2.886   3.007   3.147   3.238   3.284   3.302   3.315   3.327   3.352   3.390   3.465   3.559
I =  5:   2.785   2.820   2.978   2.974   3.112   3.278   3.409   3.473   3.507   3.533   3.557   3.615   3.696   3.801   3.902
I =  6:   2.820   2.959   2.937   3.052   3.240   3.460   3.638   3.755   3.812   3.956   3.900   4.005   4.142   4.281   4.351
I =  7:   2.805   2.947   2.949   3.113   3.341   3.626   3.964   4.026   4.106   4.168   4.230   4.379   4.565   4.724   4.772
I =  8:   2.779   2.823   2.944   3.140   3.410   3.748   4.034   4.231   4.327   4.403   4.479   4.659   4.879   5.044   5.062
I =  9:   2.755   2.809   2.939   3.152   3.445   3.811   4.123   4.338   4.443   4.526   4.609   4.806   5.040   5.207   5.207
I = 10:   2.754   2.799   2.936   3.162   3.473   3.863   4.196   4.426   4.538   4.626   4.715   4.924   5.170   5.336   5.321
I = 11:   2.745   2.790   2.933   3.173   3.502   3.916   4.270   4.514   4.634   4.728   4.821   5.042   5.298   5.463   5.432
I = 12:   2.733   2.778   2.935   3.204   3.577   4.049   4.453   4.733   4.871   4.978   5.084   5.329   5.607   5.762   [illegible]
I = 13:   2.749   2.800   2.971   3.271   3.697   4.242   4.710   5.031   5.188   5.310   5.429   5.699   5.991   6.125   6.005
I = 14:   2.836   2.904   3.087   3.406   3.857   4.459   4.951   5.300   5.465   5.591   5.712   5.983   6.263   6.370   6.222
I = 15:   2.959   3.059   3.251   3.568   4.020   4.590   5.053   5.377   5.528   5.643   5.752   5.992   6.240   6.336   6.210
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

          OPTIMIZED  W(I,J,K) AT K =  1,  J =  1 TO  15              0.0 METERS ABOVE THE GROUND

I =  1:   0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
I =  2:   0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
I =  3:   0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
I =  4:   0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
I =  5:   0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
I =  6:   0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
I =  7:   0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
I =  8:   0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
I =  9:   0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
I = 10:   0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
I = 11:   0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
I = 12:   0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
I = 13:   0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
I = 14:   0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
I = 15:   0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
```

```
              OPTIMIZED  W(I,J,K) AT K =  2,  J =  1 TO  15          0.50 METERS ABOVE THE GROUND

I =  1:   0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0         0.0
I =  2:   0.0      0.007    0.010    0.015    0.017    0.019    0.019    0.016    0.013    0.007    0.004    0.004    0.001   -0.001       0.0
I =  3:   0.0      0.009    0.012    0.015    0.017    0.019    0.017    0.013    0.006   -0.002   -0.003   -0.000   -0.001   [illegible]  0.0
I =  4:   0.0      0.010    0.013    0.014    0.018    0.019    0.014    0.009   -0.002   -0.011   -0.013   -0.014   -0.005   -0.014       0.0
I =  5:   0.0      0.010    0.012    0.015    0.016    0.016    0.011    0.002   -0.007   -0.021   -0.024   -0.010   -0.009   -0.015       0.0
I =  6:   0.0      0.011    0.012    0.013    0.015    0.014    0.008   -0.002   -0.019   -0.032   -0.031   -0.015   -0.014   -0.007       0.0
I =  7:   0.0      0.010    0.012    0.012    0.014    0.011    0.004   -0.010   -0.027   -0.041   -0.041   -0.020   -0.017   -0.008       0.0
I =  8:   0.0      0.010    0.005    0.005    0.006    0.002   -0.005   -0.017   -0.035   -0.053   -0.050   -0.027   -0.020   -0.010       0.0
I =  9:   0.0      0.004    0.000   -0.005   -0.007   -0.015   -0.021   -0.034   -0.048   -0.063   -0.059   -0.031   -0.023   -0.009       0.0
I = 10:   0.0     -0.003   -0.009   -0.018   -0.020   -0.033   -0.037   -0.047   -0.052   -0.070   -0.063   -0.035   -0.025   -0.009       0.0
I = 11:   0.0     -0.001   -0.015   -0.022   -0.022   -0.035   -0.039   -0.049   -0.058   -0.065   -0.056   -0.036   -0.022   -0.004       0.0
I = 12:   0.0     -0.002   -0.005   -0.010   -0.014   -0.018   -0.022   -0.029   -0.039   -0.053   -0.044   -0.024   -0.019   -0.004       0.0
I = 13:   0.0     -0.001   -0.005   -0.008   -0.010   -0.013   -0.017   -0.020   -0.030   -0.035   -0.031   -0.021   -0.013   -0.005       0.0
I = 14:   0.0     -0.002   -0.005   -0.010   -0.011   -0.014   -0.014   -0.017   -0.020   -0.023   -0.023   -0.012   -0.009   -0.002       0.0
I = 15:   0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0         0.0

              OPTIMIZED  W(I,J,K) AT K =  3,  J =  1 TO  15          1.00 METERS ABOVE THE GROUND

I =  1:   0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0         0.0
I =  2:   0.0      0.010    0.015    0.021    0.025    0.028    0.028    0.022    0.018    0.011    0.006    0.006    0.002   -0.001       0.0
I =  3:   0.0      0.012    0.018    0.021    0.024    0.028    0.024    0.019    0.009   -0.002   -0.004   -0.000   -0.001   -0.004       0.0
I =  4:   0.0      0.014    0.019    0.020    0.025    0.026    0.020    0.012   -0.003   -0.016   -0.019   -0.025   -0.009   -0.005       0.0
I =  5:   0.0      0.015    0.018    0.021    0.024    0.023    0.016    0.003   -0.011   -0.030   -0.035   -0.014   -0.013   -0.007       0.0
I =  6:   0.0      0.016    0.017    0.018    0.021    0.020    0.012   -0.003   -0.027   -0.045   -0.046   -0.023   -0.019   -0.009       0.0
I =  7:   0.0      0.015    0.017    0.017    0.020    0.015    0.006   -0.014   -0.032   -0.053   -0.059   -0.027   -0.024   -0.011       0.0
I =  8:   0.0      0.013    0.008    0.006    0.008    0.003   -0.007   -0.028   -0.051   -0.073   -0.072   -0.039   -0.026   -0.012       0.0
I =  9:   0.0      0.004    0.000   -0.007   -0.011   -0.021   -0.030   -0.050   -0.069   -0.093   -0.084   -0.044   -0.031   -0.012       0.0
I = 10:   0.0     -0.003   -0.013   -0.026   -0.029   -0.047   -0.054   -0.069   -0.084   -0.100   -0.091   -0.052   -0.035   -0.011       0.0
I = 11:   0.0     -0.002   -0.021   -0.032   -0.032   -0.051   -0.055   -0.070   -0.094   -0.093   -0.094   -0.050   -0.032   -0.011       0.0
I = 12:   0.0     -0.001   -0.009   -0.015   -0.021   -0.027   -0.032   -0.042   -0.057   -0.072   -0.044   -0.036   -0.027   -0.010       0.0
I = 13:   0.0     -0.002   -0.008   -0.012   -0.015   -0.020   -0.025   -0.030   -0.043   -0.051   -0.046   -0.031   -0.013   -0.007       0.0
I = 14:   0.0     -0.003   -0.009   -0.014   -0.016   -0.021   -0.022   -0.026   -0.029   -0.033   -0.033   -0.018   -0.013   -0.003       0.0
I = 15:   0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0         0.0

              OPTIMIZED  W(I,J,K) AT K =  4,  J =  1 TO  15          1.60 METERS ABOVE THE GROUND

I =  1:   0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0         0.0
I =  2:   0.0      0.011    0.017    0.023    0.027    0.031    0.030    0.025    0.020    0.012    0.007    0.006    0.002   -0.002       0.0
I =  3:   0.0      0.013    0.019    0.023    0.027    0.030    0.027    0.021    0.009   -0.002   -0.004   -0.000   -0.001   -0.004       0.0
I =  4:   0.0      0.015    0.020    0.022    0.028    0.029    0.022    0.013   -0.003   -0.017   -0.020   -0.015   -0.018   [illegible]  0.0
I =  5:   0.0      0.016    0.019    0.023    0.026    0.025    0.017    0.003   -0.012   -0.032   -0.039   -0.015   -0.014   -0.009       0.0
I =  6:   0.0      0.018    0.019    0.020    0.023    0.022    0.013   -0.004   -0.029   -0.050   -0.048   -0.025   -0.021   -0.009       0.0
I =  7:   0.0      0.015    0.018    0.019    0.021    0.017    0.006   -0.016   -0.042   -0.064   -0.054   -0.032   -0.026   [illegible]  0.0
I =  8:   0.0      0.015    0.009    0.006    0.008    0.002   -0.009   -0.031   -0.057   -0.080   -0.079   -0.044   -0.031   -0.012       0.0
I =  9:   0.0      0.006   -0.000   -0.008   -0.012   -0.024   -0.034   -0.055   -0.076   -0.093   -0.092   -0.049   [illegible] -0.013     0.0
I = 10:   0.0     -0.003   -0.015   -0.029   -0.032   -0.052   -0.059   -0.075   -0.097   -0.110   -0.100   -0.057   -0.039   -0.012       0.0
I = 11:   0.0     -0.002   -0.024   -0.035   -0.036   -0.055   -0.062   -0.078   -0.093   -0.103   -0.103   -0.057   -0.035   -0.011       0.0
I = 12:   0.0     -0.001   -0.010   -0.017   -0.023   -0.030   -0.036   -0.048   -0.064   -0.080   -0.071   -0.039   -0.029   -0.007       0.0
I = 13:   0.0     -0.002   -0.010   -0.014   -0.019   -0.023   -0.029   -0.034   -0.048   -0.057   -0.051   -0.034   -0.020   -0.007       0.0
I = 14:   0.0     -0.004   -0.009   -0.016   -0.019   -0.024   -0.025   -0.030   -0.033   -0.038   -0.037   -0.021   -0.014   -0.003       0.0
I = 15:   0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0         0.0
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```
          OPTIMIZED  W(I,J,K) AT K =  5,  J =  1 TO  15             2.60 METERS ABOVE THE GROUND

I =  1:   0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
I =  2:   0.0     0.012   0.019   0.026   0.030   0.033   0.033   0.027   0.022   0.014   0.009  -0.007   0.002  -0.002   0.0
I =  3:   0.0     0.015   0.022   0.025   0.029   0.033   0.029   0.023   0.010  -0.002  -0.014  -0.009  -0.001  -0.004   0.0
I =  4:   0.0     0.017   0.022   0.024   0.031   0.032   0.025   0.014  -0.003  -0.017  -0.021  -0.016  -0.008  -0.005   0.0
I =  5:   0.0     0.018   0.022   0.026   0.029   0.028   0.019   0.003  -0.013  -0.034  -0.041  -0.015  -0.014  -0.008   0.0
I =  6:   0.0     0.019   0.021   0.022   0.026   0.024   0.014  -0.004  -0.032  -0.054  -0.052  -0.027  -0.022  -0.009   0.0
I =  7:   0.0     0.017   0.019   0.020   0.023   0.018   0.005  -0.019  -0.047  -0.070  -0.070  -0.035  -0.028  -0.011   0.0
I =  8:   0.0     0.015   0.008   0.006   0.007   0.001  -0.011  -0.036  -0.064  -0.087  -0.087  -0.048  -0.033  -0.012   0.0
I =  9:   0.0     0.007  -0.001  -0.013  -0.015  -0.028  -0.038  -0.052  -0.084  -0.108  -0.101  -0.054  -0.038  -0.013   0.0
I = 10:   0.0    -0.001  -0.017  -0.032  -0.035  -0.057  -0.065  -0.033  -0.107  -0.119  -0.110  -0.063  -0.042  -0.012   0.0
I = 11:   0.0    -0.003  -0.025  -0.040  -0.040  -0.062  -0.069  -0.035  -0.102  -0.113  -0.113  -0.053  -0.038  -0.011   0.0
I = 12:   0.0    -0.001  -0.012  -0.021  -0.028  -0.035  -0.042  -0.055  -0.072  -0.088  -0.079  -0.044  -0.032  -0.003   0.0
I = 13:   0.0    -0.003  -0.012  -0.016  -0.022  -0.028  -0.034  -0.040  -0.055  -0.064  -0.058  -0.039  -0.023  -0.007   0.0
I = 14:   0.0    -0.004  -0.011  -0.019  -0.023  -0.028  -0.030  -0.035  -0.039  -0.043  -0.043  -0.025  -0.016  -0.003   0.0
I = 15:   0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0

          OPTIMIZED  W(I,J,K) AT K =  6,  J =  1 TO  15             7.60 METERS ABOVE THE GROUND

I =  1:   0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
I =  2:   0.0     0.017   0.027   0.032   0.036   0.041   0.041   0.034   0.027   0.018   0.012   0.010   0.004  -0.002   0.0
I =  3:   0.0     0.017   0.028   0.033   0.037   0.042   0.037   0.028   0.014   0.002  -0.003   0.002   0.000  -0.004   0.0
I =  4:   0.0     0.021   0.029   0.031   0.039   0.040   0.031   0.018  -0.002  -0.017  -0.022  -0.005  -0.007  -0.004   0.0
I =  5:   0.0     0.023   0.028   0.032   0.036   0.035   0.024   0.004  -0.016  -0.038  -0.046  -0.018  -0.014  -0.004   0.0
I =  6:   0.0     0.024   0.026   0.027   0.031   0.030   0.015  -0.007  -0.039  -0.062  -0.062  -0.032  -0.022  -0.005   0.0
I =  7:   0.0     0.020   0.022   0.021   0.025   0.018   0.003  -0.028  -0.060  -0.084  -0.086  -0.044  -0.029  -0.006   0.0
I =  8:   0.0     0.015   0.005   0.001   0.002  -0.007  -0.022  -0.053  -0.084  -0.108  -0.108  -0.051  -0.037  -0.006   0.0
I =  9:   0.0     0.006  -0.007  -0.020  -0.025  -0.041  -0.055  -0.094  -0.109  -0.131  -0.126  -0.070  -0.043  -0.006   0.0
I = 10:   0.0    -0.002  -0.025  -0.043  -0.048  -0.074  -0.084  -0.107  -0.132  -0.145  -0.136  -0.079  -0.047  -0.006   0.0
I = 11:   0.0    -0.006  -0.035  -0.053  -0.057  -0.083  -0.091  -0.113  -0.131  -0.142  -0.140  -0.080  -0.043  -0.005   0.0
I = 12:   0.0    -0.005  -0.021  -0.034  -0.044  -0.055  -0.064  -0.080  -0.098  -0.113  -0.104  -0.060  -0.037  -0.003   0.0
I = 13:   0.0    -0.004  -0.020  -0.029  -0.038  -0.048  -0.055  -0.064  -0.077  -0.088  -0.081  -0.055  -0.029  -0.002   0.0
I = 14:   0.0    -0.007  -0.018  -0.031  -0.039  -0.048  -0.052  -0.058  -0.062  -0.066  -0.064  -0.041  -0.025  -0.002   0.0
I = 15:   0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0

          OPTIMIZED  W(I,J,K) AT K =  7,  J =  1 TO  15            17.60 METERS ABOVE THE GROUND

I =  1:   0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
I =  2:   0.0     0.023   0.037   0.038   0.038   0.043   0.045   0.038   0.031   0.023   0.016   0.013   0.006  -0.003   0.0
I =  3:   0.0     0.016   0.034   0.038   0.040   0.045   0.043   0.033   0.019   0.008   0.003   0.006   0.005  -0.001   0.0
I =  4:   0.0     0.023   0.033   0.036   0.044   0.045   0.037   0.021   0.003  -0.011  -0.017  -0.000  -0.000   0.003   0.0
I =  5:   0.0     0.028   0.033   0.037   0.040   0.040   0.029   0.005  -0.015  -0.034  -0.041  -0.014  -0.004   0.003   0.0
I =  6:   0.0     0.027   0.028   0.028   0.032   0.031   0.016  -0.011  -0.041  -0.061  -0.063  -0.030  -0.011   0.013   0.0
I =  7:   0.0     0.020   0.019   0.015   0.018   0.012  -0.005  -0.039  -0.069  -0.090  -0.093  -0.047  -0.019   0.015   0.0
I =  8:   0.0     0.011  -0.004  -0.013  -0.014  -0.024  -0.040  -0.074  -0.102  -0.122  -0.122  -0.059  -0.029   0.016   0.0
I =  9:   0.0     0.000  -0.021  -0.037  -0.044  -0.062  -0.076  -0.107  -0.131  -0.147  -0.142  -0.080  -0.035   0.017   0.0
I = 10:   0.0    -0.008  -0.033  -0.050  -0.058  -0.093  -0.106  -0.131  -0.152  -0.162  -0.155  -0.090  -0.039   0.017   0.0
I = 11:   0.0    -0.013  -0.049  -0.073  -0.080  -0.107  -0.118  -0.140  -0.156  -0.164  -0.160  -0.093  -0.038   0.016   0.0
I = 12:   0.0    -0.013  -0.039  -0.059  -0.074  -0.088  -0.098  -0.115  -0.131  -0.140  -0.131  -0.078  -0.035   0.018   0.0
I = 13:   0.0    -0.012  -0.036  -0.054  -0.070  -0.084  -0.095  -0.103  -0.116  -0.121  -0.114  -0.078  -0.033   0.013   0.0
I = 14:   0.0    -0.011  -0.031  -0.054  -0.071  -0.088  -0.094  -0.100  -0.103  -0.105  -0.101  -0.071  -0.039   0.003   0.0
I = 15:   0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
```

```
            OPTIMIZED  W(I,J,K) AT K =  8,  J =  1 TO  15            27.60 METERS ABOVE THE GROUND

I =  1:   0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
I =  2:   0.0     0.028   0.047   0.039   0.035   0.042   0.044   0.032   0.033   0.024   0.020   0.016   0.018  -0.003   0.0
I =  3:   0.0     0.011   0.037   0.040   0.037   0.046   0.045   0.035   0.023   0.014   0.009   0.012   0.010   0.002   0.0
I =  4:   0.0     0.022   0.035   0.037   0.044   0.047   0.047   0.025   0.028  -0.004  -0.009   0.007   0.009   0.012   0.0
I =  5:   0.0     0.031   0.035   0.037   0.040   0.041   0.031   0.029  -0.017  -0.026  -0.033  -0.016   0.009   0.024   0.0
I =  6:   0.0     0.028   0.025   0.025   0.028   0.028   0.015  -0.012  -0.038  -0.055  -0.059  -0.023   0.005   0.036   0.0
I =  7:   0.0     0.015   0.011   0.006   0.009   0.002  -0.013  -0.046  -0.073  -0.089  -0.091  -0.042  -0.012   0.043   0.0
I =  8:   0.0     0.004  -0.015  -0.029  -0.031  -0.042  -0.056  -0.088  -0.112  -0.121  -0.126  -0.057  -0.012   0.045   0.0
I =  9:   0.0    -0.008  -0.035  -0.055  -0.063  -0.081  -0.094  -0.122  -0.142  -0.15   -0.148  -0.081  -0.019   0.047   0.0
I = 10:   0.0    -0.016  -0.052  -0.078  -0.087  -0.112  -0.123  -0.145  -0.153  -0.177  -0.152  -0.091  -0.023   0.048   0.0
I = 11:   0.0    -0.021  -0.053  -0.092  -0.102  -0.127  -0.139  -0.159  -0.172  -0.177  -0.142  -0.097  -0.025   0.048   0.0
I = 12:   0.0    -0.021  -0.055  -0.084  -0.103  -0.122  -0.127  -0.143  -0.155  -0.161  -0.150  -0.099  -0.026   0.046   0.0
I = 13:   0.0    -0.019  -0.052  -0.080  -0.103  -0.122  -0.133  -0.141  -0.157  -0.151  -0.143  -0.098  -0.034   0.033   0.0
I = 14:   0.0    -0.015  -0.044  -0.078  -0.105  -0.129  -0.139  -0.145  -0.146  -0.145  -0.139  -0.102  -0.053   0.009   0.0
I = 15:   0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0

            OPTIMIZED  W(I,J,K) AT K =  9,  J =  1 TO  15            37.60 METERS ABOVE THE GROUND

I =  1:   0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
I =  2:   0.0     0.034   0.053   0.040   0.030   0.055   0.042   0.039   0.034   0.028   0.023   0.019   0.017  -0.024   0.0
I =  3:   0.0     0.034   0.039   0.040   0.035   0.043   0.045   0.038   0.028   0.019   0.015   0.018   0.015   0.005   0.0
I =  4:   0.0     0.021   0.035   0.037   0.042   0.045   0.042   0.027   0.014   0.001  -0.001   0.016   0.020   0.022   0.0
I =  5:   0.0     0.033   0.035   0.036   0.038   0.040   0.033   0.013  -0.004  -0.012  -0.024   0.005   0.025   0.042   0.0
I =  6:   0.0     0.028   0.024   0.027   0.023   0.024   0.014  -0.012  -0.015  -0.047  -0.051  -0.012   0.029   0.053   0.0
I =  7:   0.0     0.017   0.012  -0.005  -0.004  -0.008  -0.027  -0.051  -0.075  -0.088  -0.087  -0.034   0.019   0.075   0.0
I =  8:   0.0    -0.004  -0.029  -0.045  -0.049  -0.059  -0.070  -0.099  [illegible] [illegible] -0.121  -0.053   0.018   0.080   0.0
I =  9:   0.0    -0.016  -0.050  -0.074  -0.093  -0.100  -0.111  -0.134  -0.151  -0.152  -0.157  -0.078   0.000   0.082   0.0
I = 10:   0.0    -0.023  -0.057  -0.098  -0.109  -0.132  -0.141  [illegible] [illegible] -0.173  -0.164  [illegible] -0.025   0.083   0.0
I = 11:   0.0    -0.030  -0.080  -0.114  -0.127  -0.159  -0.150  -0.177  [illegible] [illegible] [illegible] [illegible] -0.028   0.092   0.0
I = 12:   0.0    -0.030  [illegible] -0.139  -0.133  -0.181  -0.159  -0.171  [illegible] -0.161  -0.159  [illegible] -0.014   0.077   0.0
I = 13:   0.0    -0.026  -0      -0.136  -0.138  -0.167  -0.173  -0.179  [illegible] [illegible] -0.171  -0.117  -0.033   0.057   0.0
I = 14:   0.0    -0.019  -0.     -0.134  -0.142  -0.175  -0.189  -0.194  [illegible] [illegible] -0.181  -0.135  -0.068   0.017   0.0
I = 15:   0.0     0.0     0.      0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0

            OPTIMIZED  W(I,J,K) AT K = 10,  J =  1 TO  15            47.60 METERS ABOVE THE GROUND

I =  1:   0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
I =  2:   0.0     0.040   0.059   0.041   0.024   0.030   0.040   0.042   0.036   0.041   0.047   0.027   0.012  -0.005   0.0
I =  3:   0.0    -0.023   0.041   0.049   0.033   0.042   0.045   0.041   0.031   0.034   0.021   0.025   0.023   0.009   0.0
I =  4:   0.0     0.019   0.035   0.036   0.042   0.045   0.044   0.033   0.027  [illegible] 0.017   0.026   0.032   0.033   0.0
I =  5:   0.0     0.035   0.037   0.035   0.035   0.039   0.035   0.017  [illegible] [illegible] 0.015   0.017   0.042   0.057   0.0
I =  6:   0.0     0.028   0.021   0.015   0.017   0.022   0.013  -0.017  [illegible] [illegible] -0.045  [illegible] [illegible] 0.091   0.0
I =  7:   0.0     0.007  -0.005  -0.016  -0.015  -0.018  -0.027  -0.055  [illegible] [illegible] -0.087  [illegible] [illegible] [illegible] 0.0
I =  8:   0.0    -0.012  -0.043  -0.052  -0.057  -0.075  -0.084  -0.109  -0.127  -0.134  -0.131  [illegible] [illegible] [illegible] 0.0
I =  9:   0.0    -0.025  -0.055  -0.093  -0.103  -0.119  -0.126  -0.144  [illegible] [illegible] -0.159  [illegible] [illegible] [illegible] 0.0
I = 10:   0.0    -0.035  -0.084  -0.115  -0.132  -0.153  -0.159  -0.175  -0.154  [illegible] [illegible] [illegible] 0.015  [illegible] 0.0
I = 11:   0.0    -0.047  -0.098  -0.137  -0.152  -0.178  -0.183  -0.195  -0.203  [illegible] [illegible] [illegible] [illegible] [illegible] 0.0
I = 12:   0.0    -0.047  -0.094  -0.136  -0.153  -0.183  -0.197  -0.197  -0.207  [illegible] -0.192  -0.153  [illegible] [illegible] 0.0
I = 13:   0.0    -0.033  -0.088  -0.134  -0.173  -0.202  -0.213  -0.215  [illegible] [illegible] -0.207  -0.134  [illegible] [illegible] 0.0
I = 14:   0.0    [illegible] -0.079  -0.131  -0.180  -0.223  -0.247  -0.266  -0.243  [illegible] [illegible] -0.167  [illegible] [illegible] 0.0
I = 15:   0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
```

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- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
X-COMPONENT INSTABILITIES HAVE BEEN DETECTED AT    1293 LOCATIONS. LOCAL DIFFUSIVITIES HAVE BEEN ADJUSTED ACCORDINGLY.

MAXIMUM X-COMPONENT DIFFUSIVITY REQUIRED IS  357.    M**2/SEC. AT I =  1, J =  1, K = 10

MINIMUM X-COMPONENT DIFFUSIVITY ENCOUNTERED IS  100.     M**2/SEC. AT I =  1, J =  1, K =  1
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Y-COMPONENT INSTABILITIES HAVE BEEN DETECTED AT     956 LOCATIONS. LOCAL DIFFUSIVITIES HAVE BEEN ADJUSTED ACCORDINGLY.

MAXIMUM Y-COMPONENT DIFFUSIVITY REQUIRED IS  350.    M**2/SEC. AT I = 14, J = 14, K = 10

MINIMUM Y-COMPONENT DIFFUSIVITY ENCOUNTERED IS  100.     M**2/SEC. AT I =  1, J =  1, K =  1

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Z-COMPONENT INSTABILITIES HAVE BEEN DETECTED AT      33 LOCATIONS. LOCAL DIFFUSIVITIES HAVE BEEN ADJUSTED ACCORDINGLY.

MAXIMUM Z-COMPONENT DIFFUSIVITY REQUIRED IS  1.34    M**2/SEC. AT I = 14, J =  8, K = 10

MINIMUM Z-COMPONENT DIFFUSIVITY ENCOUNTERED IS  1.00    M**2/SEC. AT I =  1, J =  1, K =  1
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -


               CONVERGENCE TREND OF CONC.-SOR

               ITERATION NO.          RELATIVE ERROR
                    300                0.0012722
                    301                0.0012550
                    302                0.0012379
                    303                0.0012217
                    304                0.0012054
                    305                0.0011911
                    306                0.0011740
                    307                0.0011587
                    308                0.0011425
                    309                0.0011272
                    310                0.0011120
                    311                0.0010959
                    312                0.0010815
                    313                0.0010672
                    314                0.0010519
                    315                0.0010357
                    316                0.0010233
                    317                0.0010090
                    318                0.0009947

               CONC.-SOR CONVERGED !!
```

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- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

            CONCENTRATION FIELD :  C(I,J,K)

         C(I,J,K) PPM :  K =  1,  J =  1 TO  15       0.09 METERS ABOVE THE GROUND

I =  1:    0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  2:    0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  3:    0.05   0.05   0.05   0.06   0.21   0.12   0.08   0.07   0.07   0.06   0.06   0.06   0.05   0.05   0.05
I =  4:    0.05   0.05   0.06   0.25   3.94   0.82   0.35   0.22   0.18   0.15   0.12   0.09   0.07   0.06   0.05
I =  5:    0.05   0.05   0.06   0.19   1.28   0.74   0.45   0.33   0.28   0.24   0.20   0.15   0.11   0.08   0.05
I =  6:    0.05   0.05   0.06   0.14   0.55   0.58   0.46   0.39   0.35   0.31   0.26   0.21   0.15   0.11   0.06
I =  7:    0.05   0.05   0.05   0.12   0.42   0.47   0.43   0.39   0.37   0.34   0.28   0.25   0.19   0.14   0.08
I =  8:    0.05   0.05   0.06   0.11   0.32   0.40   0.39   0.38   0.37   0.34   0.29   0.26   0.21   0.16   0.11
I =  9:    0.05   0.05   0.06   0.10   0.28   0.37   0.38   0.37   0.35   0.34   0.29   0.27   0.22   0.17   0.12
I = 10:    0.05   0.05   0.05   0.09   0.25   0.34   0.35   0.35   0.34   0.32   0.29   0.27   0.22   0.18   0.13
I = 11:    0.05   0.05   0.05   0.09   0.22   0.29   0.31   0.31   0.31   0.30   0.26   0.25   0.22   0.19   0.14
I = 12:    0.05   0.05   0.05   0.08   0.17   0.25   0.28   0.29   0.29   0.28   0.26   0.25   0.23   0.20   0.16
I = 13:    0.05   0.05   0.05   0.07   0.13   0.19   0.22   0.23   0.24   0.24   0.23   0.23   0.22   0.20   0.18
I = 14:    0.05   0.05   0.05   0.06   0.10   0.13   0.16   0.17   0.18   0.18   0.18   0.18   0.19   0.19   0.18
I = 15:    0.05   0.05   0.05   0.06   0.06   0.08   0.10   0.11   0.11   0.12   0.12   0.14   0.15   0.16   0.18

         C(I,J,K) PPM :  K =  2,  J =  1 TO  15       0.50 METERS ABOVE THE GROUND

I =  1:    0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  2:    0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  3:    0.05   0.05   0.05   0.06   0.21   0.12   0.08   0.07   0.07   0.06   0.06   0.06   0.05   0.05   0.05
I =  4:    0.05   0.05   0.06   0.24   3.75   0.82   0.35   0.22   0.19   0.17   0.12   0.09   0.07   0.06   0.05
I =  5:    0.05   0.05   0.05   0.19   1.25   0.74   0.45   0.33   0.28   0.24   0.20   0.15   0.11   0.08   0.05
I =  6:    0.05   0.05   0.05   0.14   0.55   0.58   0.46   0.39   0.35   0.31   0.26   0.21   0.15   0.11   0.06
I =  7:    0.05   0.05   0.05   0.12   0.42   0.47   0.43   0.39   0.37   0.34   0.29   0.25   0.19   0.14   0.08
I =  8:    0.05   0.05   [illegible]   0.11   0.32   0.40   0.39   0.38   0.36   0.34   0.30   0.27   0.21   0.16   0.11
I =  9:    0.05   0.05   [illegible]   0.10   0.28   0.37   0.38   0.37   0.36   0.34   0.30   0.27   0.22   0.17   0.12
I = 10:    0.05   0.05   [illegible]   0.09   0.25   0.34   0.35   0.35   0.34   0.32   0.29   0.27   0.22   0.18   0.13
I = 11:    0.05   0.05   [illegible]   0.09   0.22   0.30   0.31   0.32   0.31   0.30   0.27   0.26   0.22   0.19   0.14
I = 12:    0.05   0.05   0.05   0.08   0.18   0.25   0.28   0.29   0.29   0.28   0.26   0.25   0.23   0.20   0.16
I = 13:    0.05   0.05   [illegible]   0.07   0.13   0.19   0.22   0.23   0.24   0.24   0.23   0.23   0.22   0.20   0.19
I = 14:    0.05   0.05   0.05   0.06   0.10   0.13   0.16   0.17   0.18   0.19   0.19   0.18   0.19   0.18   0.19
I = 15:    0.05   0.05   0.05   0.06   0.06   0.08   0.10   0.11   0.11   0.12   0.12   0.14   0.15   0.17   0.18

         C(I,J,K) PPM :  K =  3,  J =  1 TO  15       1.00 METERS ABOVE THE GROUND

I =  1:    0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  2:    0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  3:    0.05   0.05   0.05   0.06   0.21   0.12   0.08   0.07   0.07   0.06   0.06   0.06   0.05   0.05   0.05
I =  4:    0.05   0.05   0.06   0.24   3.52   0.81   0.35   0.22   0.18   0.15   0.12   0.09   0.07   0.06   0.05
I =  5:    0.05   0.05   0.05   0.19   1.27   0.73   0.45   0.33   0.28   0.24   0.20   0.15   0.11   0.09   0.05
I =  6:    0.05   0.05   0.05   0.14   0.55   0.59   0.46   0.39   0.34   0.31   0.27   0.21   0.15   0.11   0.06
I =  7:    0.05   0.05   0.05   0.12   0.42   0.47   0.43   0.39   0.36   0.34   0.30   0.25   0.19   0.14   0.08
I =  8:    0.05   0.05   0.05   0.11   0.32   0.40   0.39   0.38   0.36   0.34   0.31   0.27   0.21   0.16   0.11
I =  9:    0.05   0.05   0.05   0.10   0.28   0.37   0.37   0.37   0.35   0.34   0.30   0.27   0.22   0.17   0.12
I = 10:    0.05   0.05   0.06   0.09   0.25   0.34   0.35   0.35   0.34   0.33   0.30   0.27   0.22   0.18   0.13
I = 11:    0.05   0.05   0.05   0.09   0.22   0.30   0.32   0.32   0.30   0.31   0.29   0.26   0.23   0.19   0.14
I = 12:    0.05   0.05   0.05   0.08   0.18   0.25   0.28   0.29   0.29   0.28   0.27   0.25   0.23   0.20   0.16
I = 13:    0.05   0.05   0.05   0.07   0.13   0.19   0.22   0.23   0.24   0.24   0.23   0.23   0.22   0.20   0.19
I = 14:    0.05   0.05   0.05   0.06   0.10   0.13   0.16   0.17   0.18   0.19   0.19   0.18   0.19   0.18   0.19
I = 15:    0.05   0.05   0.05   0.06   0.06   0.08   0.10   0.11   0.11   0.12   0.12   0.14   0.15   0.17   0.18
```

```
             C(I,J,K) PPM :  K =  4,  J =  1 TO  15   1.60 METERS ABOVE THE GROUND

I =  1:   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  2:   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  3:   0.05   0.05   0.05   0.06   0.21   0.12   0.08   0.07   0.07   0.06   0.06   0.06   0.05   0.05   0.05
I =  4:   0.05   0.05   0.05   0.23   3.05   0.77   0.34   0.22   0.18   0.15   0.13   0.09   0.07   0.06   0.05
I =  5:   0.05   0.05   0.06   0.18   1.24   0.73   0.45   0.33   0.28   0.24   0.21   0.15   0.11   0.09   0.05
I =  6:   0.05   0.05   0.05   0.14   0.65   0.59   0.46   0.38   0.34   0.31   0.27   0.21   0.15   0.11   0.06
I =  7:   0.05   0.05   0.05   0.12   0.42   0.47   0.42   0.39   0.36   0.34   0.30   0.25   0.19   0.14   0.08
I =  8:   0.05   0.05   0.06   0.11   0.32   0.40   0.39   0.38   0.35   0.34   0.31   0.27   0.21   0.16   0.11
I =  9:   0.05   0.05   0.05   0.10   0.28   0.37   0.37   0.36   0.35   0.34   0.31   0.27   0.22   0.17   0.12
I = 10:   0.05   0.05   0.06   0.09   0.25   0.34   0.35   0.35   0.34   0.33   0.30   0.27   0.22   0.18   0.13
I = 11:   0.05   0.05   0.05   0.09   0.22   0.31   0.32   0.33   0.32   0.31   0.29   0.26   0.23   0.18   0.14
I = 12:   0.05   0.05   0.05   0.08   0.19   0.25   0.28   0.29   0.29   0.28   0.27   0.26   0.23   0.20   0.16
I = 13:   0.05   0.05   0.05   0.07   0.13   0.19   0.22   0.23   0.24   0.24   0.23   0.23   0.22   0.20   0.18
I = 14:   0.05   0.05   0.05   0.06   0.10   0.13   0.16   0.17   0.19   0.18   0.18   0.18   0.19   0.18   0.18
I = 15:   0.05   0.05   0.05   0.06   0.06   0.08   0.10   0.11   0.11   0.12   0.12   0.14   0.15   0.17   0.18

             C(I,J,K) PPM :  K =  5,  J =  1 TO  15   2.60 METERS ABOVE THE GROUND

I =  1:   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  2:   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  3:   0.05   0.05   0.05   0.06   0.20   0.12   0.08   0.07   0.07   0.06   0.06   0.06   0.05   0.05   0.05
I =  4:   0.05   0.05   0.05   0.21   2.37   0.74   0.33   0.21   0.17   0.15   0.13   0.09   0.07   0.06   0.05
I =  5:   0.05   0.05   0.06   0.18   1.17   0.71   0.44   0.32   0.27   0.24   0.21   0.15   0.11   0.08   0.05
I =  6:   0.05   0.05   0.05   0.14   0.63   0.57   0.45   0.37   0.34   0.31   0.26   0.21   0.15   0.11   0.06
I =  7:   0.05   0.05   0.05   0.12   0.41   0.46   0.42   0.38   0.36   0.34   0.31   0.25   0.19   0.14   0.08
I =  8:   0.05   0.05   0.05   0.10   0.32   0.40   0.39   0.37   0.35   0.34   0.32   0.27   0.21   0.16   0.10
I =  9:   0.05   0.05   0.06   0.10   0.28   0.35   0.37   0.36   0.35   0.33   0.31   0.27   0.22   0.17   0.12
I = 10:   0.05   0.05   0.05   0.09   0.25   0.34   0.35   0.35   0.34   0.33   0.31   0.27   0.23   0.18   0.13
I = 11:   0.05   0.05   0.06   0.09   0.22   0.31   0.33   0.33   0.32   0.31   0.30   0.27   0.23   0.18   0.14
I = 12:   0.05   0.05   0.05   0.08   0.18   0.25   0.28   0.29   0.29   0.28   0.28   0.26   0.23   0.20   0.16
I = 13:   0.05   0.05   0.05   0.07   0.13   0.19   0.22   0.23   0.24   0.24   0.24   0.23   0.22   0.20   0.18
I = 14:   0.05   0.05   0.05   0.06   0.10   0.13   0.16   0.17   0.18   0.18   0.18   0.18   0.19   0.18   0.18
I = 15:   0.05   0.05   0.05   0.06   0.06   0.08   0.10   0.11   0.11   0.12   0.12   0.14   0.15   0.17   0.19

             C(I,J,K) PPM :  K =  5,  J =  1 TO  15   7.60 METERS ABOVE THE GROUND

I =  1:   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  2:   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  3:   0.05   0.05   0.05   0.06   0.14   0.10   0.08   0.07   0.07   0.06   0.06   0.06   0.05   0.05   0.05
I =  4:   0.05   0.05   0.05   0.12   0.73   0.40   0.24   0.17   0.14   0.13   0.12   0.09   0.07   0.06   0.05
I =  5:   0.05   0.05   0.06   0.12   0.51   0.49   0.35   0.27   0.23   0.21   0.19   0.14   0.10   0.07   0.05
I =  6:   0.05   0.05   0.06   0.11   0.44   0.46   0.38   0.32   0.29   0.27   0.25   0.20   0.15   0.10   0.06
I =  7:   0.05   0.05   0.05   0.10   0.33   0.40   0.37   0.34   0.32   0.30   0.29   0.24   0.18   0.13   0.08
I =  8:   0.05   0.05   0.05   0.09   0.27   0.35   0.35   0.33   0.32   0.31   0.30   0.26   0.21   0.16   0.10
I =  9:   0.05   0.05   0.06   0.09   0.24   0.32   0.33   0.32   0.31   0.30   0.30   0.26   0.22   0.17   0.11
I = 10:   0.05   0.05   0.06   0.09   0.22   0.30   0.32   0.31   0.30   0.30   0.29   0.26   0.22   0.17   0.12
I = 11:   0.05   0.05   0.05   0.08   0.20   0.28   0.31   0.30   0.30   0.29   0.29   0.26   0.23   0.18   0.13
I = 12:   0.05   0.05   0.05   0.08   0.16   0.23   0.27   0.27   0.27   0.27   0.27   0.25   0.23   0.20   0.16
I = 13:   0.05   0.05   0.05   0.07   0.13   0.18   0.21   0.22   0.22   0.23   0.23   0.23   0.22   0.20   0.18
I = 14:   0.05   0.05   0.05   0.06   0.09   0.13   0.15   0.16   0.17   0.17   0.18   0.18   0.18   0.18   0.18
I = 15:   0.05   0.05   0.05   0.06   0.06   0.08   0.09   0.11   0.11   0.12   0.12   0.13   0.15   0.16   0.18
```

```
              C(I,J,K) PPM :  K =  7,  J =  1 TO  15        17.60 METERS ABOVE THE GROUND

I =  1:    0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  2:    0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  3:    0.05   0.05   0.05   0.05   0.07   0.07   0.06   0.06   0.05   0.06   0.05   0.05   0.05   0.05   0.05
I =  4:    0.05   0.05   0.05   0.06   0.14   0.13   0.11   0.09   0.09   0.09   0.08   0.07   0.05   0.06   0.05
I =  5:    0.05   0.05   0.05   0.07   0.15   0.15   0.15   0.13   0.12   0.12   0.11   0.10   0.08   0.07   0.06
I =  6:    0.05   0.05   0.05   0.07   0.15   0.18   0.17   0.16   0.15   0.15   0.15   0.13   0.11   0.09   0.08
I =  7:    0.05   0.05   0.05   0.07   0.14   0.17   0.18   0.17   0.17   0.17   0.17   0.15   0.13   0.10   0.08
I =  8:    0.05   0.05   0.05   0.07   0.13   0.16   0.18   0.17   0.17   0.17   0.17   0.15   0.14   0.12   0.09
I =  9:    0.05   0.05   0.05   0.07   0.12   0.15   0.17   0.17   0.17   0.17   0.17   0.17   0.15   0.13   0.10
I = 10:    0.05   0.05   0.05   0.07   0.12   0.15   0.17   0.17   0.17   0.17   0.17   0.17   0.15   0.14   0.11
I = 11:    0.05   0.05   0.05   0.07   0.11   0.15   0.17   0.17   0.17   0.17   0.17   0.17   0.15   0.14   0.12
I = 12:    0.05   0.05   0.05   0.06   0.10   0.14   0.15   0.16   0.15   0.16   0.17   0.17   0.16   0.15   0.14
I = 13:    0.05   0.05   0.05   0.06   0.09   0.11   0.13   0.14   0.14   0.14   0.15   0.15   0.15   0.15   0.15
I = 14:    0.05   0.05   0.05   0.06   0.07   0.09   0.11   0.11   0.12   0.12   0.12   0.13   0.14   0.14   0.15
I = 15:    0.05   0.05   0.05   0.05   0.06   0.07   0.08   0.09   0.09   0.09   0.10   0.10   0.11   0.13   0.14

              C(I,J,K) PPM :  K =  9,  J =  1 TO  15        27.60 METERS ABOVE THE GROUND

I =  1:    0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  2:    0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  3:    0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  4:    0.05   0.05   0.05   0.05   0.06   0.05   0.06   0.05   0.06   0.06   0.06   0.06   0.05   0.05   0.05
I =  5:    0.05   0.05   0.05   0.05   0.07   0.07   0.07   0.07   0.07   0.07   0.07   0.07   0.06   0.05   0.05
I =  6:    0.05   0.05   0.05   0.05   0.07   0.08   0.08   0.08   0.08   0.08   0.08   0.08   0.07   0.07   0.06
I =  7:    0.05   0.05   0.05   0.06   0.07   0.08   0.09   0.09   0.09   0.09   0.09   0.09   0.08   0.08   0.07
I =  8:    0.05   0.05   0.05   0.06   0.07   0.08   0.09   0.09   0.09   0.09   0.09   0.09   0.09   0.08   0.08
I =  9:    0.05   0.05   0.05   0.05   0.07   0.08   0.09   0.09   0.09   0.09   0.09   0.09   0.09   0.09   0.08
I = 10:    0.05   0.05   0.05   0.06   0.07   0.08   0.09   0.09   0.09   0.09   0.09   0.09   0.09   0.09   0.09
I = 11:    0.05   0.05   0.05   0.05   0.07   0.09   0.09   0.09   0.09   0.09   0.09   0.09   0.10   0.09   0.09
I = 12:    0.05   0.05   0.05   0.05   0.07   0.07   0.08   0.08   0.09   0.09   0.09   0.09   0.10   0.10   0.09
I = 13:    0.05   0.05   0.05   0.05   0.06   0.07   0.07   0.08   0.08   0.08   0.08   0.09   0.10   0.10   0.10
I = 14:    0.05   0.05   0.05   0.05   0.06   0.06   0.07   0.07   0.07   0.07   0.07   0.08   0.10   0.10   0.11
I = 15:    0.05   0.05   0.05   0.05   0.06   0.06   0.06   0.06   0.06   0.06   0.07   0.07   0.09   0.09   0.10

              C(I,J,K) PPM :  K =  9.  J =  1 TO  15        37.60 METERS ABOVE THE GROUND

I =  1:    0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  2:    0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  3:    0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  4:    0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  5:    0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.06   0.05   0.05   0.05   0.05
I =  6:    0.05   0.05   0.05   0.05   0.05   0.06   0.06   0.06   0.06   0.06   0.06   0.06   0.06   0.06   0.05
I =  7:    0.05   0.05   0.05   0.05   0.05   0.05   0.06   0.06   0.06   0.06   0.06   0.05   0.06   0.06   0.06
I =  8:    0.05   0.05   0.05   0.05   0.05   0.06   0.06   0.06   0.06   0.06   0.06   0.06   0.05   0.05   0.06
I =  9:    0.05   0.05   0.05   0.05   0.05   0.06   0.06   0.06   0.06   0.05   0.06   0.05   0.05   0.07   0.06
I = 10:    0.05   0.05   0.05   0.05   0.05   0.06   0.06   0.06   0.06   0.06   0.05   0.06   0.05   0.07   0.07
I = 11:    0.05   0.05   0.05   0.05   0.05   0.06   0.06   0.06   0.06   0.06   0.05   0.05   0.07   0.07   0.07
I = 12:    0.05   0.05   0.05   0.05   0.05   0.05   0.06   0.06   0.06   0.05   0.05   0.06   0.07   0.07   0.07
I = 13:    0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.06   0.06   0.06   0.06   0.06   0.07   0.07
I = 14:    0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.06   0.06   0.07   0.07
I = 15:    0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.06   0.06   0.07
```

```
       C(I,J,K) PPM :  K = 10,  J =  1 TO  15     47.60 METERS ABOVE THE GROUND
I =  1:   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  2:   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  3:   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  4:   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  5:   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  6:   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  7:   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  8:   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I =  9:   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I = 10:   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I = 11:   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I = 12:   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I = 13:   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I = 14:   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
I = 15:   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05   0.05
```

```
**** HORIZONTAL CONCENTRATION PROFILE AT   1.50 METERS ABOVE THE GROUND SURFACE ****

     I = 1  TO  I = 15  -------->

J= 1    2      2      2      2      2      2      2    2 2 2 2    2      2      2      2
J= 2    2      2      2      2      2      2      2    2 2 2 2    2      2      2      2
J= 3    2      2      2      2      2      2      2    2 2 2 2    2      2      2      2
J= 4    2      2      2      7      6      5      4    3 3 3 3    3      2      2      2
J= 5    2      2      7      M      *      +      -    - 9 8 7    6      4      3      2
J= 6    2      2      +      -      +      +      +    - - - -    8      6      4      3
J= 7    2      2      3      -      -      +      -    - - - -    9      7      5      3
J= 8    2      2      2      7      -      -      -    - - - -    -      8      6      4
J= 9    2      2      2      5      9      -      -    - - - -    -      8      6      4
J=10    2      2      2      5      8      -      -    - - - -    9      9      6      4
J=11    2      2      2      4      7      9      -    - - - -    9      8      6      4
J=12    2      2      2      3      5      7      8    9 9 9 9    8      8      5      5
J=13    2      2      2      2      4      5      6    7 7 7 7    8      7      6      6
J=14    2      2      2      2      3      3      4    5 6 6 6    6      7      5      4
J=15    2      2      2      2      2      2      3    3 4 4 5    5      6      5      4

NOTE .... X - Y COORDINATE SCALE IS DISTORTED  IN THIS PLOT.

* * * * *  LEGEND  * * * * *

M : MAX. CONC. = [illegible]
# : [illegible]
? : [illegible]
> : 70 % OF MAX. CONC.
& : 60 % OF MAX. CONC.
$ : 50 % OF MAX. CONC.
" : 40 % OF MAX. CONC.
= : 30 % OF MAX. CONC.
+ : 20 % OF MAX. CONC.
- : 10 % OF MAX. CONC.
9 :  9 % OF MAX. CONC.
8 :  8 % OF MAX. CONC.
7 :  7 % OF MAX. CONC.
6 :  6 % OF MAX. CONC.
5 :  5 % OF MAX. CONC.
4 :  4 % OF MAX. CONC.
3 :  3 % OF MAX. CONC.
2 :  2 % OF MAX. CONC.
1 :  1 % OF MAX. CONC.
. : LESS THAN 1 % OF MAX. CONC.
0 : ABSOLUTE ZERO CONCENTRATION
```