

US EPA ARCHIVE DOCUMENT

**AIR MODULE PRE- AND POSTPROCESSOR
BACKGROUND AND IMPLEMENTATION FOR
THE MULTIMEDIA, MULTIPATHWAY, AND
MULTIRECEPTOR RISK ASSESSMENT (3MRA)
FOR HWIR99**

Work Assignment Manager
and Technical Direction:

Stephen M. Kroner
U.S. Environmental Protection Agency
Office of Solid Waste
Washington, DC 20460

Donna B. Schwede
U.S. Environmental Protection Agency
Office of Research and Development
Research Triangle Park, NC 27711

Prepared by:

Center for Environmental Analysis
Research Triangle Institute
3040 Cornwallis Road
Research Triangle Park, NC 27709-2194
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U.S. Environmental Protection Agency
Office of Solid Waste
Washington, DC 20460

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DISCLAIMER

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1.0 Overview

The purpose of the atmospheric modeling for the Multimedia, Multipathway and Multireceptor Risk Assessment (3MRA) for HWIR99 is to provide an annual average estimate of air concentration of dispersed constituents and annual deposition rate estimates for vapors and particles at various receptor points in the area of interest, which is defined by a 2-km radius measured from the edge of the largest area source at the site. The chemical constituents are assumed to be in the form of volatilized gases or fugitive dust emitted from area sources. The atmospheric module simulates the transport and diffusion of the constituent. The simulated air concentrations are used to estimate bio-uptake from plants and human exposures due to direct inhalation. The predicted deposition rates are used to determine chemical loadings to watershed soils, farm crop areas, and surface waters.

The atmospheric concentration and deposition of constituents can be determined in several ways. However, the selected procedure has to be computationally efficient to satisfy the HWIR requirements of numerous simulations within a Monte Carlo framework. Because the HWIR99 modeling is site-based, the steady-state Gaussian plume modeling approach was considered to be appropriate and, the Industrial Source Complex-Short Term (ISCST3) model was selected. The model provides estimates of contaminant concentration, dry deposition (particles only), and wet deposition (particles and gases) for user-specified averaging periods (i.e., annually for HWIR99).

ISCST3 is used as legacy code in the 3MRA framework. That is, the model is left intact and the necessary interfacing to the framework is handled using pre- and postprocessors. Together, the EPA air quality model (ISCST3) and the pre- and postprocessing code that integrates ISCST3 into the 3MRA environment are referred to as the Air Module. The pre- and postprocessing code also provides additional functionality to support other 3MRA framework requirements.

This document provides details on the functionality of the pre- and postprocessor code and describes the manner in which the ISCST3 model was run for HWIR99. Technical features of the ISCST3 model are described in the model user's guide (U.S. EPA, 1999a).

2.0 Air Module Pre- and Postprocessing

The major functionality provided by the pre- and postprocessing code is the following:

- # *Decision to execute ISCST3.* The determination is made whether a given site/waste management unit (WMU) combination has already been run by the Air Module. If so, the preexisting ISCST3 output file is used to calculate parameters for the Air Module output file, ar.grf. If not, ISCST3 is executed with pre- and postprocessing. Postprocessing includes saving the ISC output files for future use (in the grf\lfo directory) and calculating parameters for the Air Module output file.
- # *MASSFRAX calculation.* As an option, the preprocessor calculates the source-specific, long-term average particulate mass fraction distribution (ISCST3 input variable, *MASSFRAX*) from the land-based source modules (landfill, wastepile, or land application unit) output time series *PMF* (the particle size distribution) and *PE30* (the mass flux of 30 μm or smaller particles) (see Section 2.3). The option is specified by the logical variable *MASSFRAXOption* in the ar.ssf file. If the internal calculation of *MASSFRAX* is not exercised (*MASSFRAXOption* = "T"), then *MASSFRAX* is read as a fixed distribution (it does not vary as a result of Monte Carlo sampling, nor is it WMU-specific) from the ar.ssf file. (Note: Variable names that are also 3MRA variable names, such as *MASSFRAX*, are italicized in this document.)
- # *Spline interpolation decision.* The preprocessor determines whether to execute ISCST3 to model **directly** ("ISCST3-model") to all site-specific output x-y coordinates requested by the 3MRA framework or, alternatively, to model to a prespecified (fixed) set of polar coordinates and then use a two-dimensional cubic spline method (Section 2.3) to interpolate from this polar set to the (larger) 3MRA-requested set of interest. (*NumAir* is the total number of points of interest site-wide for which Air Module outputs are required.) The spline interpolation option is used to reduce ISCST3 run time, which is directly related to *NumAir*. (Note: The spline option was not used for HWIR99. All Air Module outputs represent direct modeling by ISCST3.)

2.1 Flow of Operations

The Air Module receives inputs from its module-specific input file, ar.ssf, the generic site layout file, sl.ssf, and modeled inputs from the generic source output file, sr.grf. Outputs are written to the Air Module's output file, ar.grf. These variables are listed and described in Appendix A, Tables A-1 through A-4. In addition, meteorological data are input to the ISCST3

model through a site-based meteorological data set. The file directory containing that data set (*MetDir*, a string variable) is read by the preprocessor from the header file, *hd.ssf*. A flowchart illustrating the Air Module is shown in Figure 2-1. Although this flowchart is largely self-explanatory, an overview of the major steps follows, as described in terms of the various program functions in the code (shown in parentheses).

1. *Read in the Settings (ReadSettings)*. After initializing variables, the preprocessor opens data files for input. Initial settings are read from the *ar.ssf* file, including splining options and whether volatiles or particulates are being run or both. If the *SplineOption* is true, the spline angles and distances are read from the *ar.ssf* file. Emissions data from the *sr.grf* file are also read.
2. *Determine If the Site Should Be Run Again (ShouldDoAgain)*. After reading initial settings, the preprocessor checks to see whether the ISCST3 model should be executed by looking in the *grf\lfo* directory to see if the *<site/WMUId>.lfo* file exists for the current site/WMU combination. If the file exists, the ISCST3 model is not run again and steps 3 through 5 are skipped.
3. *Set Up the ISC Input Files (DoIt)*. If the given site/WMU combination has not been previously processed, the preprocessor creates the ISCST3 input file for either all *NumAir* points or for the *NumSpline* (grid) points as defined by the *NumAirSplineDistance* and *NumAirSplineAngle* parameters, depending on the *SplineOption* setting.
4. *Calculate "Unnormalized" Outputs (RunAir)*. The ISCST3 model is executed. If the ISCST3 model fails to run to completion (errors out), the ISC error messages are sent to the 3MRA Warning file, the ISC *lfo* and *sav* files (if any) are deleted, and an error message is sent to the 3MRA error file that ISC has failed to execute. Refer to Section 3.0 for details on running ISCST3 for HWIR99.
5. *Run Postprocessing To Get the lfo Files in the grf\lfo Directory (RunPost, MoveFiles)*. If the *SplineOption* is true, the spline fitting routines are executed to generate the estimated values at the air receptor locations for volatiles and for particles, if present. These values are then stored in a "pseudo" *lfo* file, which is stored in the *grf\lfo* directory. This *lfo* is not a direct output from ISC; rather it contains the estimated parameter values (from the splining) and other data required for further calculations in the Air Module. It also contains dummy data for nonrelevant ISC output. If the *SplineOption* is false, ISC has modeled to the air receptor locations, so the *lfo* file is moved to the *grf\lfo* directory. Intermediate ISC model files are then deleted so they do not accumulate in the directory from which ISC is executed.
6. *For Vapors, Calculate Output Values and Write to the Air grf File (DoV)*. The appropriate values are read from the *<site/WMUId>.lfo* file for the site/WMU combination that is stored in the *grf\lfo* directory. These are multiplied by the time series emission rates for vapors (from the *sr.grf* file) to generate

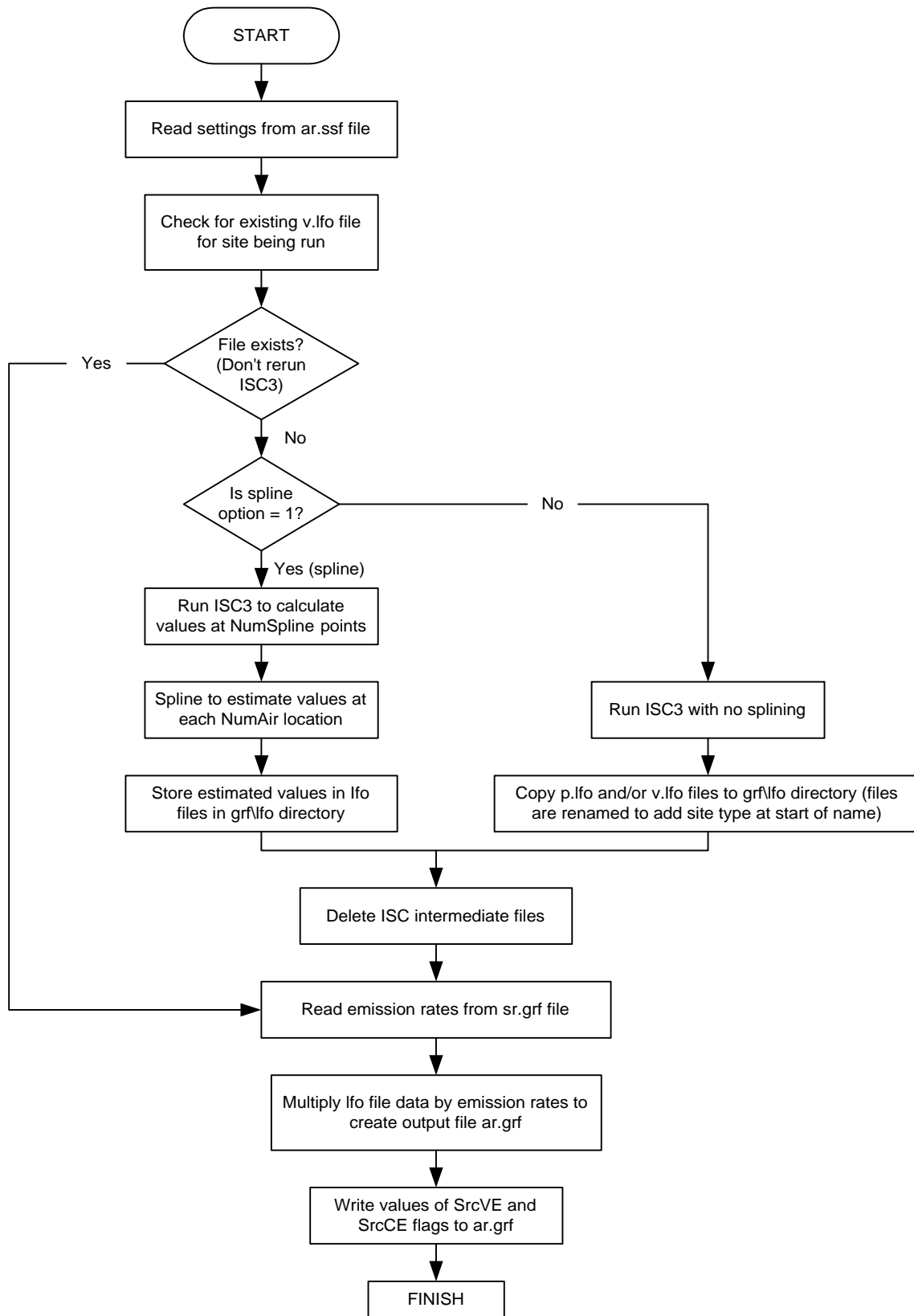


Figure 2-1. Flowchart of Air Module pre- and postprocessor functionality.

unnormalized time series outputs in the metrics of interest (concentration or deposition flux). These results are written to the 3MRA output file, ar.grf.

7. *If There Are Particles, Calculate Output Values and Write to the Air grf File (DoP).* For WMUs that generate particles (SrcCE = "T"), the appropriate values are read from the <site/WMUId>p.lfo file for the site/WMU combination that is stored in the grf\lfo directory. These are multiplied by the time series emission rates for particles (from the sr.grf file) to generate unnormalized time series outputs in the metrics of interest (concentration or deposition flux). These results are written to the 3MRA output file, ar.grf.
8. *Write the Particle and Vapor Flag Values to the Air grf File.* The values of the SrcVE and SrcCE flags are written to the ar.grf file. The program then terminates.

2.2 Pre- and Postprocessor Assumptions and Limitations

Assumptions and/or limitations implicit in the pre- and postprocessor's functionality include the following:

- # The preprocessor will not execute ISCST3 if any given site/WMU combination has been encountered previously during FRAMES runs; that is, the preprocessor simply uses the preexisting ISCST3 output for that site/WMU to generate the ar.grf file.¹ The implicit assumption is that, for a given site/WMU, nothing else (e.g., Monte Carlo sampling, receptor locations) would vary that would affect the ISCST3 outputs. In general, this is true except where aerated tanks are being modeled at a site. For aerated tanks, the tank size may vary from realization to realization since tank characteristics are randomly assigned. For this reason, when tanks are run, the area and height of the tank are incorporated into the tank LFO file name.
- # Use of the spline involves use of a preselected set of polar coordinates to which ISCST3 models, and the ISCST3 outputs at these locations are then used to fit the spline. These preselected coordinates do not vary from site to site; thus, there is no guarantee that, for any given site, they are either the best points to use for fitting the spline (the "best" points would provide good resolution in areas of maximum ISCST3 output gradients), nor is there complete assurance that they are adequate to represent the entire output surface within a reasonable interpolation error. The polar coordinates have been preselected, however, in an attempt to provide acceptable resolution (while keeping the number of polar coordinates reasonable) in areas of anticipated high gradients (i.e., close to the source).

¹ Whether the site/WMU combination has previously been run is determined by looking for the existence of the volatile emissions output file with that particular site/WMU identification, i.e., <site/WMUId>.v.lfo. This file, containing normalized transport outputs, is always generated if that site/WMU combination has been run.

2.3 Pre- and Postprocessor Methodology

Much of the functionality of the pre- and postprocessors is related to run-time decisions (e.g., spline/no spline, run ISCST3/copy preexisting results) and input/output activities. This overall functionality is presented in the flowchart in Figure 1. The remaining functionality involving scientific or technical calculations includes the estimation of the long-term average particle size distribution and the interpolating spline algorithm. These two procedures are described below.

2.3.1 MASSFRAX Calculation

MASSFRAX is the long-term average particle size distribution required by ISCST3 when particulates are modeled. The land-based source modules (i.e., the LAU, WP, and LF) output time series of particle size distributions, i.e., one distribution per year, as well as a time series of particulate mass fluxes for particles less than or equal to 30 μm in diameter. From these inputs, the Air Module preprocessor estimates *MASSFRAX* as

$$MASSFRAX_j = \frac{\sum_{i=1}^{PE30NY} PMF_{ij} \cdot PE30_i}{\sum_{i=1}^{PE30NY} PE30_i} \quad j = 1, \dots, 4 \quad (2-1)$$

where

j = particle size category index. (The four size categories are 2.5 μm and less, 2.5 to 10 μm , 10 to 15 μm , and 15 to 30 μm .)

PMF_{ij} = source model output particle size distribution for category j and year i

$PE30_i$ = mass flux rate ($\text{g}/\text{m}^2\text{-d}$) for 30- μm or less particles for the i^{th} year

$PE30NY$ = is the number of years in the PE30 time series.

2.3.2 Splining Algorithm

A two-dimensional cubic spline interpolation algorithm has been developed and implemented as an option in the Air Module to minimize run time of ISCST3. Under this option, run-time savings are achieved by using ISCST3 to model **directly** to a smaller number of air output points than the total number of points at which air outputs are required across the site (*NumAir* points). The data set to which ISCST3 models directly under the spline option will be called here the “NumSpline” data set. The number of points in the NumSpline data set is calculated as $(NumAirSplineDist + 2) * (NumAirSplineAngle) + 1$. *NumAirSplineDist* is the number of concentric circles in the polar grid lying on a circumscribing circle or outside of the WMU boundary. (The two additional concentric circles in the above formula consist of (1) a circle

inscribing the WMU, and (2) a circle lying midway between the inscribing circle and the WMU center. The one additional point is a point at the center of the WMU.) *NumAirSplineAngle* is the number of angles that the 360° polar grid is disaggregated into; that is, *NumAirSplineAngle* = 4 would result in 4 quadrants of 90° each. In general, the x-y coordinates of the points making up the NumSpline data set are not a subset of the *NumAir* x-y coordinates; rather, they are at different locations. A requirement of the spline algorithm used by the Air Module is that the data provided to the spline must be “complete” in the sense that, however the underlying two-dimensional grid is configured (e.g., cartesian, polar), data must be provided at each intersection of the two dimensions. The spline method can only interpolate values. Consequently, value estimates cannot be made for any points located outside of the outermost grid circle, which is chosen to be 2 km from the edge of the WMU.

Once the preprocessor determines that the site/WMU combination has not been processed previously and that splining is appropriate, the overall procedure for splining is as follows:

1. Convert the NumSpline points from the polar grid to a cartesian grid for input to ISCST3. (A polar grid is used as the basis for the NumSpline points because, under the “complete” data set requirement of the spline algorithm, a polar grid can achieve a higher resolution in the region of steepest output gradients [near the WMU] with fewer total points than can a cartesian coordinate system.)
2. Apply ISCST3 directly to the NumSpline points now on a cartesian grid.
3. Fit the spline to the ISCST3 output data at the NumSpline points. If any interpolated values are negative, reset those values to zero and write a warning message to the warning file. Note: The spline is fitted to ISCST3’s “normalized” outputs, i.e., unit transport coefficients. As previously stated, interpolated, normalized outputs are then multiplied by source module emission rates to result in final (“unnormalized”) Air Module outputs. The spline could be fitted to the final unnormalized outputs, but this would require more processing and storage—with identical results—because the final outputs are time series outputs, whereas the normalized outputs are time-invariant.
4. Use the fitted spline to spatially interpolate normalized outputs for each of the *NumAir* points of interest. Note that, in general, the NumSpline points and the *NumAir* points have no common points and *NumAir* points are interpolated. To illustrate using an extreme, but illustrative, example, if NumSpline were 81 and *NumAir* were 82, then, assuming SplineOption = 1, ISCST3 would first be run for the 81 NumSpline points, the spline would then be fitted to these points and used to interpolate to the 82 (different) *NumAir* points. In this example, of course, the spline option would have minimal, if any, run-time savings. In general, the splining method would be applied in the cases where NumSpline is a relatively small fraction of *NumAir*.

Some illustrative results of splined results as compared to nonsplined (ISCST3 only) results are presented in Figures 2-2 through 2-4. Figure 2-2 shows the spatial distribution of the vapor wet deposition flux rate across site number 0223504 for a land application unit WMU as simulated only by ISCST3; that is, all *NumAir* points (428 in this example) were modeled directly by ISCST3. (The 0,0 coordinate represents the center of the square WMU.) Figures 2-3a and 2-4a show the flux distribution resulting from the spline interpolation when the spline was fit using, respectively, 145 and 97 *NumSpline* points. (The spline parameter values producing these points are *NumSpline* = 145, *NumAirSplineAngle* = 12, and *NumAirSplineDist* = 10. For *NumSpline* = 97, the parameters were *NumAirSplineAngle* = 8 and *NumAirSplineDist* = 10.) Figures 3b and 4b show the spatial distribution of the interpolation error, i.e. the “true” ISCST3 results (Figure 2) minus interpolated results, for the two respective spline fits. For both sets of splined results, the interpolation errors are reasonably small. As would be expected, the smaller *NumSpline* data set (97) does indicate slightly more interpolation error in certain regions, although the differences are quite marginal in this particular example.

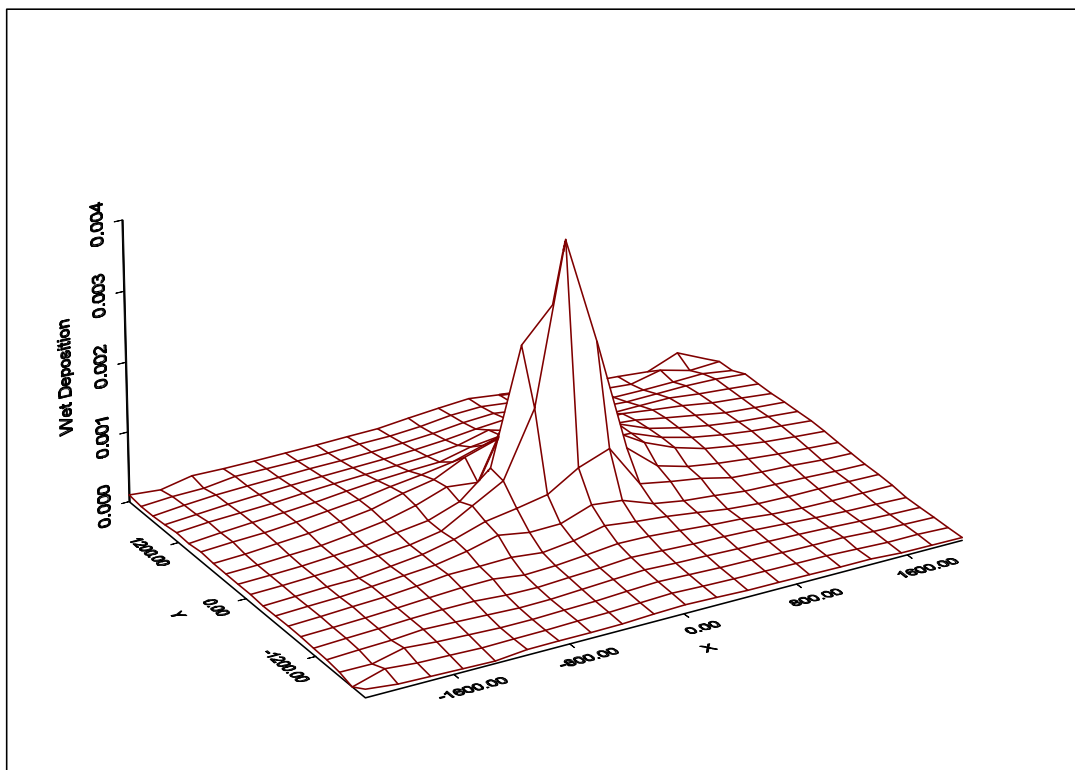


Figure 2-2. Air Module output (no spline interpolation).

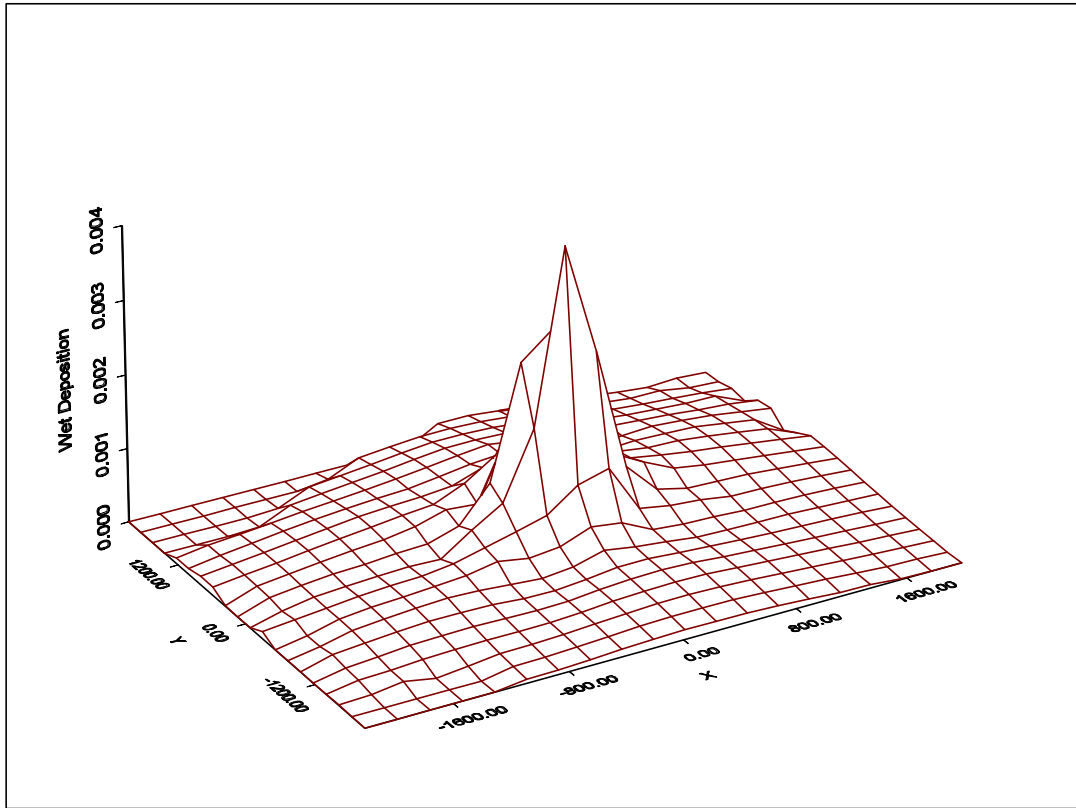


Figure 2-3a. Spline-interpolated Air Module output (145 NumSpline points).

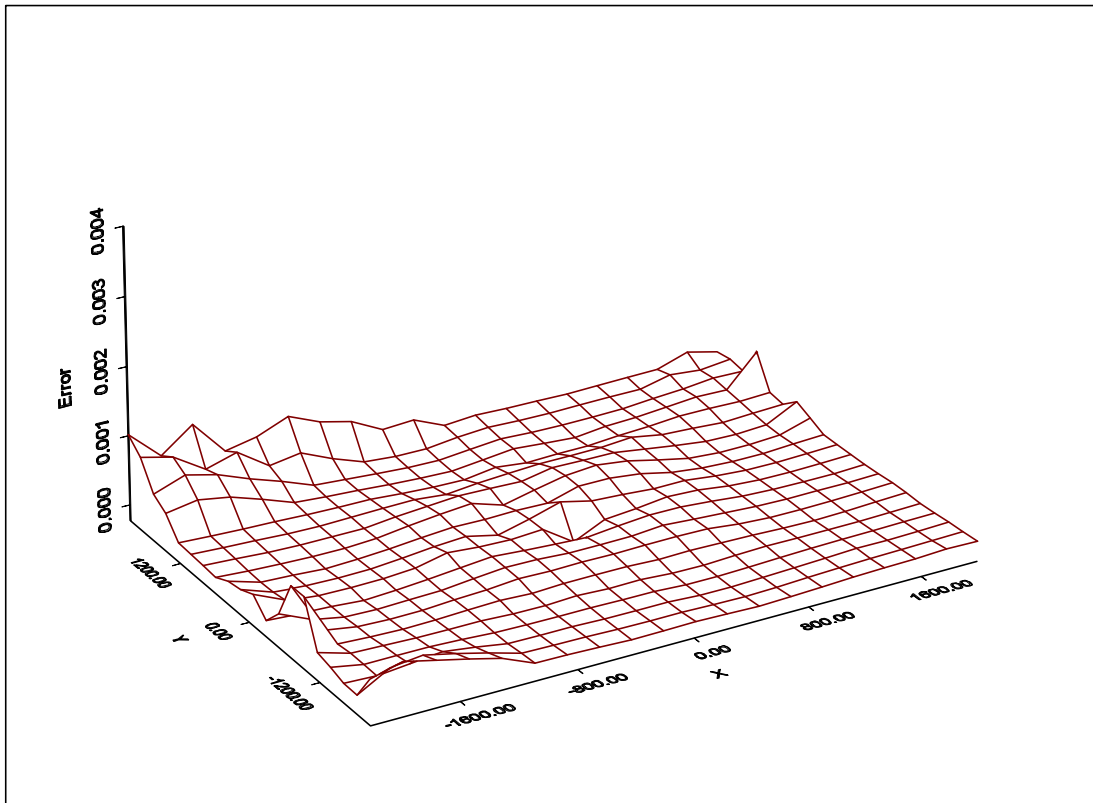


Figure 2-3b. Interpolation errors (145 NumSpline points).

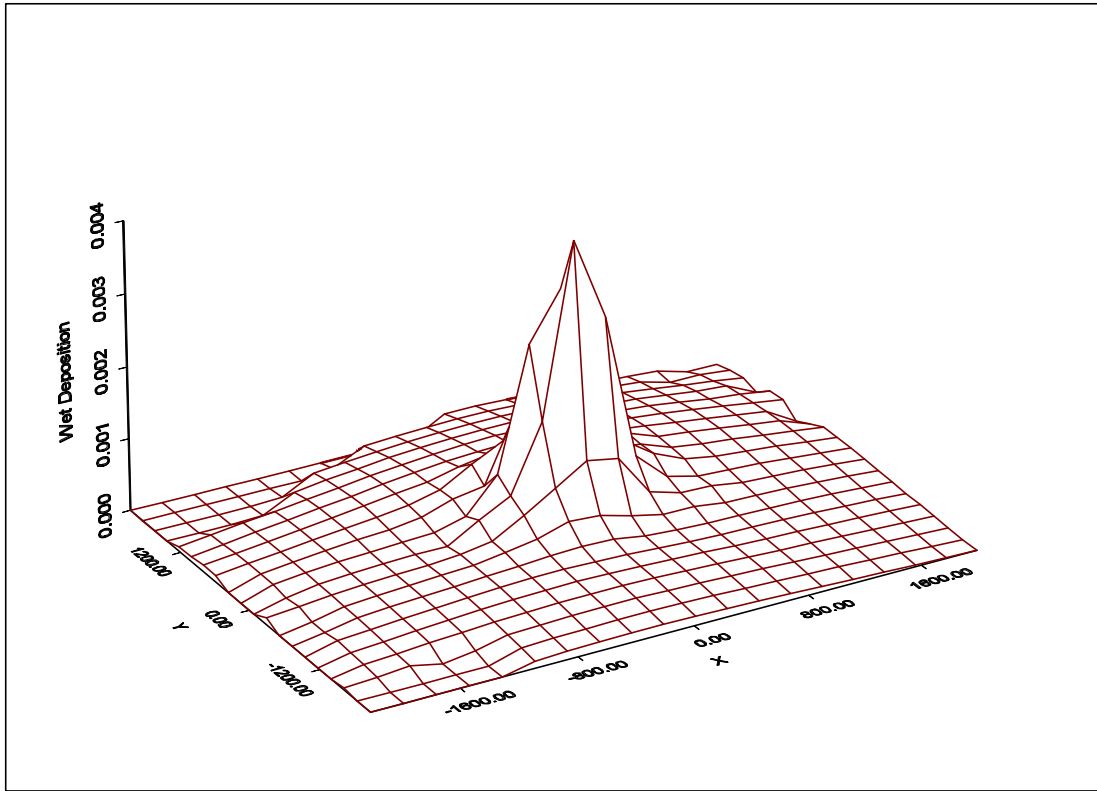


Figure 2-4a. Spline-interpolated Air Module output (97 NumSpline points).

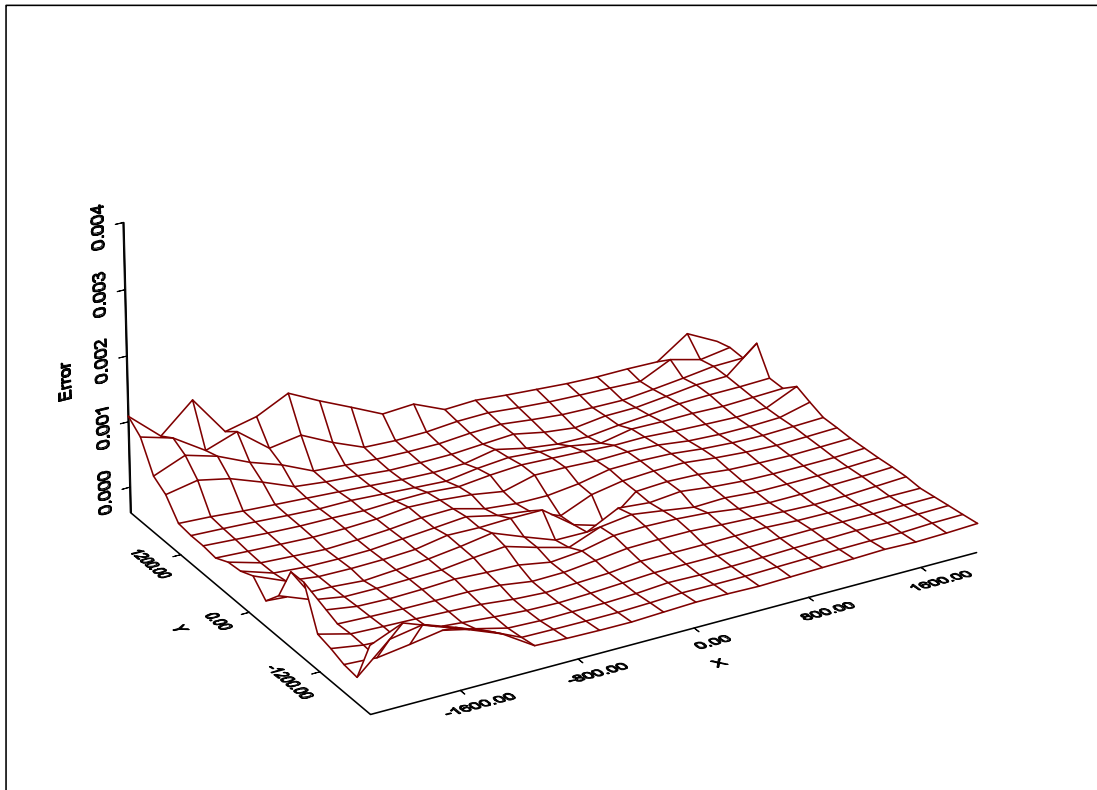


Figure 2-4b. Interpolation errors (97 NumSpline points).

3.0 ISCST3 Model

3.1 Model Features

To address specific needs (mostly relating to computational burden) of HWIR99, several new features were added to ISCST3. These new features are summarized in this section. A complete description of the technical algorithms in the HWIR99-specific version of ISCST3 (ISCST3-HWIR) is provided in U.S. EPA (1999a). The operational instructions are in U.S. EPA (1999b).

3.1.1 Revised Plume Depletion Scheme

The version of ISCST3 distributed by EPA's Office of Air Quality Planning and Standards contains the Horst (1983) plume depletion algorithm. This algorithm was found to be computationally intensive and gave spurious results for some cases. A new plume depletion and settling algorithm developed by Venkatram (1998) was implemented into ISCST3-HWIR resulting in a faster, more robust approach. This approach is based on depleting material in a surface-based internal boundary layer that grows with distance from the source. In conjunction with this change, the deposition velocity algorithm was also modified by removing the inertial impaction term. The inclusion of this term appears to provide deposition velocity estimates that are too high for some particle sizes.

3.1.2 Sampled Chronological Input Model (SCIM)

To reduce model run time, an option was added to ISCST3-HWIR to sample the long-term meteorological record at regular, user-specified intervals and scale the model results at the end of the run to produce the annual average estimates. This method is called Sampled Chronological Input Model (SCIM). An advantage of this method is that hourly meteorology is used that maintains the serial correlation between wet deposition and concentration. The user specifies two sampling intervals. Using the first interval, the meteorological data are sampled, ignoring any recorded precipitation, and the concentration and dry deposition are calculated for each receptor location of interest. The second interval specifies the sampling rate for the hours of meteorological data during which precipitation was recorded. This sampling rate is used to determine the concentration, dry deposition, and wet deposition. The estimates from these separate schemes are combined at the end of the model run using a weighted average based on the number of hours sampled.

3.1.3 Output by Particle Size

For HWIR99, inhalation risks are determined for pollutants with particle sizes $\leq 10 \mu\text{m}$. Therefore, a new output option was required to allow examination of concentration and deposition by particle size.

3.2 Model Implementation for HWIR99

The following sections describe the options used for running ISCST3-HWIR for the 3MRA for HWIR99.

3.2.1 Model Control Parameters

As indicated in Section 2.1, the input file for ISCST3-HWIR is generated by the Air Module preprocessor based on the module-specific input file, ar.ssf, the generic site layout file, sl.ssf, modeled inputs from the generic source output file, sr.grf, and certain “hard-wired” options. The following options used by ISCST3-HWIR are identical for each model run:

- # Calms processing routine is used
- # Missing data processing routine is used
- # SCIM is used
- # Plume depletion due to dry (particles only) and wet (vapors and particles) deposition is considered.

The use of rural or urban dispersion parameters is selected on a site-by-site basis. The type of model output depends on the facility, with concentration, dry deposition, and wet deposition being calculated for land application units, waste piles, and landfills. Only concentration and wet deposition were calculated for the surface impoundments and aerated tanks because the pollutants are only in the gaseous phase.

3.2.2 Source Parameters

All sources for HWIR99 are modeled as area sources by ISCST3-HWIR. The location and size of the sources is determined from data in the 1985 *Screening Survey for Industrial Subtitle D Establishments* (Westat, 1987), except for tank dimensions, which are obtained from the 1986 survey of hazardous waste treatment, storage, and disposal facilities (U.S. EPA, 1987). All sources are assumed to be at ground level except for wastepiles and aerated tanks, the height of which is imputed from area and waste loading data from these sources. Section 3.0 of *Data Collection for the Hazardous Waste Identification Rule* (U.S. EPA, 1999c) describes the collection of WMU data in detail.

While calculating a source-specific, long-term average particulate mass fraction distribution (MASSFRAXOption in Section 2.3) is certainly desirable, the use of such a variable

distribution makes it necessary to rerun ISCST3 with each Monte Carlo sampling. Consequently, to minimize run time, a fixed distribution for all sources was used, thereby enabling complete reuse of ISCST3 outputs from sample to sample. The four size categories that were modeled are 30 -15 μm , 15-10 μm , 10-2.5 μm and < 2.5 μm with mass fractions of 0.4, 0.1, 0.3, and 0.2, respectively.

ISCST3 requires the user to input two scavenging coefficients for each particle size category: one for liquid precipitation and one for frozen precipitation. Scavenging coefficients for particles were taken from Figure 1-11 in Volume 2 of the ISC3 User's Guide (U.S. EPA, 1999a). They were assigned based on the size of the particles. Frozen and liquid precipitation were assumed to scavenge particles at the same rate.

Typically, ISCST3 is run with scavenging coefficients for gas deposition that are chemical specific. For HWIR99, there are over 40 chemicals, so this method would significantly increase the number of runs to be made. A set of gas scavenging coefficients for all chemicals was used that is based on approximating the gases as very small particles. This approach may lead to underprediction of wet deposition for some gases and overprediction of others depending on the Henry's law coefficient for the gas.

Preliminary model runs indicated that it was not feasible to run ISCST3-HWIR on an hourly basis for the lifetime of the WMU. Therefore, the decision was made to use a long-term estimate of the concentration and deposition. ISCST3-HWIR was run using normalized emissions from WMUs to produce annual average concentration and deposition estimates. These estimates are converted to yearly estimates by the Air Module postprocessor by multiplying the normalized-concentration and annual deposition predictions by the emission rate for each year. Annual averages are then divided by 365.25 to provide predictions in the required daily average units. (Depending on the quality/quantity of the data at the met stations, upwards of 30 years of data were used to create long-term annual average; 99 stations were used to describe conditions at the 201 sites.)

3.2.3 Receptor Locations

The receptor locations used in the modeling depend on the spline interpolation decision. As discussed in Section 2.0, the preprocessor determines whether to execute ISCST3 to model **directly** ("ISCST3-model") to all site-specific output x-y coordinates requested by the 3MRA framework or, alternatively, to a prespecified (fixed) set of polar coordinates and then use a two-dimensional cubic spline method (Section 2.3) to interpolate from this polar set to the (larger) 3MRA-requested set of interest. (Note: The spline option was not used for HWIR99. All Air Module outputs represent direct modeling by ISCST3.)

3.2.4 Meteorological Inputs

Meteorological data were collected regionally by meteorological station, with each of the 201 industrial D sites modeled for HWIR assigned to the nearest station with similar weather conditions and adequate weather data for the analysis. In making these assignments, EPA considered all available data from 218 meteorological stations across the United States to find the

best data for each site. This process resulted in 99 meteorological stations being matched to the 201 industrial sites. Several automated programs were developed to reduce the effort needed to prepare the data files needed by the 3MRA Model. Details about these programs and meteorological data collection in general can be found in Section 4.0 of *Data Collection for the Hazardous Waste Identification Rule* (U.S. EPA, 1999d).

Most meteorological data were extracted from Solar and Meteorological Surface Observation Network (SAMSON; U.S. DOC and U.S. DOE, 1993) hourly data files and converted as necessary to daily time series, monthly time series, annual time series, and long-term averages for use with the various media modules. Because SAMSON precipitation data were inadequate, precipitation data were obtained from cooperative station daily summaries (NCDC et al., 1995), with SAMSON data used to help allocate these daily data to hourly time series. Mixing heights were obtained from upper air station data. Land use data also were required in the vicinity of each meteorological station to derive air model inputs such as Bowen ratio, surface roughness height, minimum Monin-Obukhov length, noontime albedo, and the fraction of net radiation absorbed by the ground.

Data quality control review uncovered, along with precipitation data problems, significant portions of missing data within the various meteorological data time series required for the HWIR analysis. Programs were written to automatically find and correct these data gaps, within technical constraints established by Atkinson and Lee (1992). Once data gaps were corrected and precipitation data filled in, the data were processed through PCRAMMET to produce the files for input to ISCST3-HWIR.

Another meteorology-related input to ISCST3 is the SCIM sampling interval. A study was conducted (U.S. EPA, 1998) to determine the optimum sampling interval. The results of the study show that, for a 5-year meteorological database, setting the first sampling interval (see Section 3.1.2) to 193 hours and the second interval to 8 hours provided estimates of concentration, dry deposition, and wet deposition that were comparable to the estimates obtained using the full meteorological database. Each of the meteorological databases used in HWIR99 contains a minimum of 10 years of data, so the comparisons with the full data set should be similar to those in the study.

3.3 References

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Table A-1. AR.SSF Input Parameters (Module-Specific Inputs)

Input Parameter	Units	Description
<i>NumAirSplineDist</i>	unitless	Number of distances used to construct the polar mesh used to construct the spline
<i>NumAirSplineAngle</i>	unitless	Number of angles used to construct the polar mesh used to construct the spline
<i>AirSplineDistance</i>	m	Array of radial distances of polar mesh
<i>AirSplineAngle</i>	degrees	Array of angles used in polar mesh
<i>SplineOption</i>	unitless	Whether or not splining is an option. 0=no spline, 1=spline
<i>StartYr</i>		Required by ISCST3. Starting year of Met. file
<i>ScimStr</i>		Required by ISCST3. SCIM option
<i>RuralStr</i>		Required by ISCST3. Rural or Urban
<i>DryDpStr</i>		Required by ISCST3. Dry Depletion Option
<i>WetDpStr</i>		Required by ISCST3. Wet Depletion Option.
<i>AirData</i>		Required by ISCST3. Upper Air (Met.) Station number
<i>SurfData</i>		Required by ISCST3. Surface (Met.) Station number
<i>AnemHght</i>	m	Required by ISCST3. Anemometer height
<i>SHght</i>	m	Required by ISCST3. Source height
<i>ArrayLen</i>	unitless	Required by ISCST3. Length of array
<i>MASSFRAXOption</i>	unitless	Logical flag for whether to internally calculate <i>MASSFRAX</i> distribution (false) or read a fixed <i>MASSFRAX</i> (true) from AR.SSF.
<i>MASSFRAX</i>	fraction	Required by ISCST3. Fraction of particle size (1 dim. array for each particle-emitting source type, i.e. LAU, LF, and WP in that order)
<i>PARTDIAM</i>	μm	Required by ISCST3. Particle diameter (1 dim. array)
<i>PARTSLIQ</i>	h/s-mm	Required by ISCST3. Particle scavenging coefficient by liquid precipitation (1 dim. array)
<i>PARTSICE</i>	h/s-mm	Required by ISCST3. Particle scavenging coefficient by frozen precipitation (1 dim. array)
<i>LiqScav</i>	h/s-mm	Required by ISCST3. Gas scavenging coefficient by liquid precipitation (1 dim. array)
<i>IceScav</i>	h/s-mm	Required by ISCST3. Gas scavenging coefficient by frozen precipitation (1 dim. array)
<i>SCIMBYHR</i>	unitless	Required by ISCST3. Sets model to skim through Metfile, picking certain hours according to array specifications

Table A-2. SI.SSF Input Parameters (Module-Specific Site Layout Inputs)

Input Parameter	Units	Description
<i>AirLocX</i>	m	Array for easting in site coordinate system (for each receptor location)
<i>AirLocY</i>	m	Array for northing in site coordinate system (for each receptor location)
<i>MetSta</i>		Met. Station identifier (<MetSta>L.dat (L: long-term), <MetSta>A.dat (A: annual time series), <MetSta>M.dat (M: monthly time series), <MetSta>D.dat (D: daily time series), <MetSta>H.dat (H: hourly time series))
<i>NumAir</i>		Number of air points
<i>SettingID</i>		SrcType (*One of LAU, LF, WP, AT, SI) + SiteID
<i>SrcArea</i>	m ²	Area of source
<i>SrcLocX</i>	m	Easting in site coordinate system (Source location). 0 at source centroid
<i>SrcLocY</i>	m	Northing in site coordinate system (Source location). 0 at source centroid
<i>SrcType</i>		One of {LAU, LF, WP, AT, SI}

Table A-3. SR.SSF Input Variables (Source Module Inputs)

Variable Name	Data Type	Unit	Description
<i>CE</i>	float	g/m ² /d	Array of constituent mass emission rate-PM ₃₀
<i>PE30</i>	float	g/m ² /d	array of eroded solids mass emission rates-PM ₃₀
<i>PE30NY</i>	integer		number of years in outputs
<i>PMF</i>	float		2-dimensional array - "mass fraction", "particulate emission particle size distribution" -- "number of years in outputs", "4"
<i>VE</i>	float	g/m ² /d	array of volatile emission rates
<i>VENY</i>	integer		number of years in outputs
<i>SrcVE</i>	logical		flag for volatile emissions presence
<i>SrcCE</i>	logical		flag for chemicals sorbed to particulate emissions presence

Table A-4. Ar.grf Output Variables (Air Module Outputs)

Variable Name	Unit	Description
<i>PM10</i>	$\mu\text{g}/\text{m}^3$	2-dimensional array that provides information on total number of years of activity for PM10 at each receptor location and PM10 concentration in each year.
<i>PM10YR</i>	Year	Time series of years corresponding to this variable.
<i>PM10NY</i>	unitless	Number of years in the time series corresponding to this variable.
<i>CVap</i>	$\mu\text{g}/\text{m}^3$	2-dimensional array that provides information on total number of years of activity for volatiles at each receptor location and volatile concentration in each year.
<i>CVapYR</i>	Year	Time series of years corresponding to this variable.
<i>CVapNY</i>	unitless	Number of years in the time series corresponding to this variable.
<i>VapWDep</i>	$\text{g}/\text{m}^2/\text{d}$	2-dimensional array that provides information on total number of years of activity for vapor wet deposition at each receptor location and wet deposition flux for each year.
<i>VapWDepYR</i>	Year	Time series of years corresponding to this variable.
<i>VapWDepNY</i>	unitless	Number of years in the time series corresponding to this variable.
<i>ParDDep</i>	$\text{g}/\text{m}^2/\text{d}$	2-dimensional array that provides information on total number of years of activity for particulate dry deposition at each receptor location and dry deposition flux for each year.
<i>ParDDepYR</i>	Year	Time series of years corresponding to this variable.
<i>ParDDepNY</i>	unitless	Number of years in the time series corresponding to this variable.
<i>ParWDep</i>	$\text{g}/\text{m}^2/\text{d}$	2-dimensional array that provides information on total number of years of activity for particulate wet deposition at each receptor location and particulate wet deposition flux for each year.
<i>ParWDepYR</i>	Year	Time series of years corresponding to this variable.
<i>ParWDepNY</i>	unitless	Number of years in the time series corresponding to this variable.
<i>SrcVE</i>		Flag to tell if vapor
<i>SrcCE</i>		Flag to tell if particulate