COMPARISON OF REGULATORY DESIGN CONCENTRATIONS:

AERMOD VERSUS ISCST3 AND CTDMPLUS

draft document

April 1999

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1. INTRODUCTION

The purpose of this report, often called a consequence analysis, is to give the user community a sense of how regulatory design concentration estimates from a new air dispersion model (or procedure) compare to those from an established model (or procedure) by a series of "representative" examples. After reading model evaluation results, many modelers react with "Now, what does this mean to my modeling projects?". This analysis has been designed to answer that question by showing the effects of the new model, **AERMOD** (the **A**merican Meteorological Society/**E**nvironmental Protection Agency **R**egulatory Model Improvement Committee's Dispersion **Mod**el,) as compared to the existing regulatory models. The existing regulatory models used in this report were ISCST3 (the **I**ndustrial **S**ource **C**omplex -**S**hort **T**erm Model--Version **3**) and CTDMPLUS (the Complex Terrain Dispersion Model-Plus). This consequence analysis does not substitute for detailed comparative evaluations or sensitivity analyses, but rather, provides to the modeler some simple comparisons of regulatory design concentrations between these air quality models for a number of source scenarios.

The consequence analysis was based on comparative runs made using a composite of standard data sets. These data sets involved two meteorological data sets representing different climatic regimes, and three point sources with stack parameters characteristic of a small, medium, and large power plant. Area and volume sources have been added to the standard data sets along with two point sources (small and large power plant) in simple terrain (receptor elevations greater than the elevation of the base of the stack but below the elevation of the stack top). Although building wake effects have been added to the data sets, this effort excluded such source scenarios since AERMOD is not being proposed for regulatory applications to downwash situations.

Because AERMOD has been designed to treat sources in complex terrain, an additional component was added to the consequence analysis which addresses complex terrain, i.e., where the

receptor elevations are above the release height of the source[1]. This complex terrain analysis included its own meteorological data base and a number of stack heights, buoyancy regimes, and hill types scenarios.

After applying the model to all of the above source scenarios, the consequence analysis was summarized by tabulating the important regulatory (design) concentrations for the new model against those predicted by the existing regulatory models. Often, the regulatory concentrations of interest are the high and the high-second-highest concentrations for 1-hour, 3-hour, 24-hour, and annual averages, and they were used in this study.

1.1 A Brief Description of AERMOD[2]

A committee, AERMIC (the **A**merican Meteorological Society/**E**nvironmental Protection Agency **R**egulatory **M**odel **I**mprovement **C**ommittee), was formed to introduce state-of-the-art modeling concepts into the EPA's local-scale air quality models. AERMIC's focus was on a new platform for regulatory steady-state plume modeling; this platform would include air dispersion fundamentally based on planetary boundary layer turbulence structure, scaling and concepts. AERMOD was designed to treat both surface and elevated sources in simple and complex terrain.

Special features of AERMOD include its ability to treat the vertical inhomogeneity of the planetary boundary layer, special treatment of surface releases, irregularly-shaped area sources, a three-plume model for the convective boundary layer, and limitation of vertical mixing in the

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[1] Simple terrain includes receptors with elevations below the top of the stack and at elevations above or below the stack base. Intermediate terrain includes receptors with elevations above stack top and below the plume centerline. Complex terrain includes receptors with elevations above the top of the stack (intermediate terrain is a subset of complex terrain). Flat terrain assumes that all receptors are at the same elevation as the base of the stack.

[2] User's Guide for the AMS/EPA Regulatory Model - AERMOD, US EPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, Draft Report, November 1998. Available on the U.S. EPA web site at www.epa.gov/scram001. Select the "7th Modeling Conference" icon and the select the "AERMOD" icon to find this document.

stable boundary layer. A treatment of dispersion in the presence of intermediate and complex terrain is used that improves on that currently in use in ISCST3 and other models, yet without the complexity of a model such as CTDMPLUS.

AERMOD incorporates, with a new simple approach, current concepts about flow and dispersion in complex terrain. Where appropriate, the plume is modeled as either impacting and/or following the terrain. This approach has been designed to be physically realistic and simple to implement while avoiding the need to distinguish among simple, intermediate and complex terrain, as is required by present regulatory models. As a result, AERMOD removes the need for defining complex terrain regimes; all terrain is handled in a consistent and continuous manner that is simple while still considering the dividing streamline concept in stably-stratified conditions.

AERMOD is actually a modeling system with three separate components: AERMOD (AERMIC Dispersion Model), AERMAP (AERMOD Terrain Preprocessor), and AERMET (AERMOD Meteorological Preprocessor).

AERMET is the meteorological preprocessor for AERMOD. Input data can come from hourly cloud cover observations, surface meteorological observations and twice-a-day upper air soundings. Output includes surface meteorological observations and parameters and vertical profiles of several atmosheric parameters.

AERMAP is a terrain preprocessor designed to simplify and standardize the input of terrain data for AERMOD. Input data include receptor terrain elevation data. The terrain data may be in the form of digital terrain data that is available from the U.S. Geological Survey. For each receptor, the output includes a location and height scale, which is an elevation used for the computation of air flow around hills.

Additional information about AERMOD can be found in other documents. The Model Evaluation Document[3], which compares both old and new model predictions against measured ambient concentrations, and 2) the Model Formulation Document,[4] which provides a detailed explanation of the science behind the model, are both available on the EPA's world-wide-web site.

1.2 Overview of ISCST3[5].

ISCST3 is especially designed to support the EPA's regulatory modeling programs. This model is a steady-state Gaussian dispersion model with a number of options available to the user. These options include the use of stack-tip downwash, buoyancy-induced dispersion, final plume rise (except for sources with building downwash), a routine for processing averages when calm winds occur, and default values for wind profile exponents and for the vertical potential temperature gradients. The Short Term model also incorporates COMPLEX1 screening model dispersion algorithms for receptors in complex terrain. The user may select either rural or urban dispersion parameters, depending on the characteristics of the source location. A more detailed side-by-side explanation and comparison of features between ISCST3 and AERMOD is given in Appendix A.

1.3 A Brief Description of CTDMPLUS[6]

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[3] Model Evaluation Results for AERMOD, draft AERMIC report for US EPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, December 17, 1998. Available on the U.S. EPA web site at www.epa.gov/scram001. Select the "7th Modeling Conference" icon, then select the "AERMOD" icon to find this document.

[4] AERMOD: Description of Model Formulation, draft AERMIC report for US EPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, December 15, 1998. Available on the U.S. EPA web site at www.epa.gov/scram001. Select the "7th Modeling Conference" icon, then select the "AERMOD" icon to find this document.

[5] User's Guide for the Industrial Source Complex (ISC3) Dispersion Models, US EPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, Report No. EPA-454/B-95-003a, September 1995.

[6] User's Guide to the Complex Terrain Dispersion Model Plus Algorithm for Unstable Situations, US EPA, Atmospheric Research and Exposure Assessment Laboratory, Research Triangle Park, NC 27711, Report No. EPA/600/8-89/041, March 1989.

CTDMPLUS is a refined Gaussian plume dispersion model designed to estimate hourly concentrations of plume material from elevated point sources at receptors on or near isolated terrain features. This model can assess stable and neutral atmospheric conditions as well as daytime, unstable conditions. Its use of meteorological data and terrain information is different from other regulatory models in that considerable detail for both types of input data is required and is supplied by preprocessors specifically designed for CTDMPLUS.

In modeling stable to neutral conditions, a central feature of CTDMPLUS is its use of a critical dividing-streamline height to separate the flow in the vicinity of a hill into two separate layers. Flow in the upper layer has sufficient kinetic energy to pass over the top of the hill, while the streamlines in the lower layer are constrained to flow in a horizontal plane around the hill. In modeling unstable or convective conditions, the model relies on a probability density function (PDF) description of the vertical velocities to estimate the vertical distribution of pollutants.

Hourly profiles of wind and temperature measurements are used by CTDMPLUS to compute plume rise, plume penetration, convective scaling parameters. In stable/neutral conditions, the profiles of turbulence data are used to compute dispersion parameter values at plume height.

The model calculates on a hourly basis, how the plume trajectory is deformed by each hill. The computed concentration at each receptor is then derived from the receptor position on the hill and the resultant plume position and shape.

2. METEOROLOGICAL DATA BASES

2.1 Flat and Simple Terrain.

One year of data for two sites were retrieved and processed. The two sites selected for this study were Pittsburgh, PA (**WBAN** [**W**eather **B**ureau-**A**ir Force-**N**avy] station No. 94823), representative of an urban eastern site; and Oklahoma City, OK (WBAN station No. 13967), representative of a southwestern plains site. Data for the year 1964 were used at Pittsburgh and data for the year 1984 were used at Oklahoma City. ISCST3 meteorological (met) data were preprocessed by PCRAMMET and AERMOD met data were preprocessed by AERMET.

2.1.1 AERMET Overview. AERMET[7] provides a general purpose meteorological preprocessor for organizing available meteorological data into a format suitable for use by AERMOD. National Weather Service (NWS) hourly surface observations and twice-daily upper air soundings, plus data from an on-site meteorological measurement program can be processed in AERMET. There are three stages to processing the data. The first stage extracts meteorological data from archive data files and processes the data through various quality assessment checks. The second stage merges all data available for 24-hour periods (NWS and on-site data) and stores these data together in a single file. The third stage reads the merged meteorological data and estimates the necessary parameters for use by AERMOD. Two files are written for AERMOD: hourly boundary layer parameter estimates and a file of multiple-level observations of wind speed and direction, temperature, and standard deviation of the fluctuating horizontal and vertical components of the wind.

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[7] User's Guide for the AERMOD Meteorological Preprocessor (AERMET), Revised Draft, US EPA, Office of Air Quality Planning and Standards, RTP, NC 27711, November 1998. Available from EPA's Office of Air Quality Planning and Standards Technology Transfer Network world-wide-web site at www.epa.gov/scram001. See the "7th Modeling Conference", then select "AERMOD".

Input data include: 1) hourly specification of wind speed; 2) hourly specification of wind direction; 3) ambient temperature; 4) solar radiation (estimated)[8]; 5) a description of direction-dependent and monthly variations of surface characteristics (surface roughness, albedo, Bowen ratio); and 6) twice-daily upper air soundings[9]. Output includes hourly values for mixing heights and Monin-Obukhov lengths, surface friction velocity, convective velocity scale, and profiles of wind speed and direction, temperature and turbulence. Table 2-1 lists the albedo, Bowen ratio, and surface roughness that were assumed for this analysis.

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Table 2-1. Albedo, Bowen Ratio, and Surface Roughness length assumed for AERMET preprocessor.

Site	Option	Albedo	Bowen Ratio	Surface roughness (meters
Pittsburgh	Rural	0.25	0.75	0.15
	Urban	0.25	1.5	0.3
Oklahoma City	Rural	0.25	0.75	0.15
	Urban	0.25	1.5	0.3

[8]Solar and Meteorological Surface Observation Network 1961-1990, Version 1.0, US Department of Commerce, National Climatic Data Center, Asheville, NC / US Department of Energy, National Renewable Energy Laboratory, Golden CO, September 1993.

[9]Radiosonde Data of North America 1946-1992, Version 1.0, Forecast Systems Laboratory, Boulder, CO and National Climatic Data Center, Asheville, NC, August 1993.

2.1.2 PCRAMMET Overview. The PCRAMMET [10]model requires the twice-daily mixing heights and NWS surface observations. Prior to being made available, the data were checked for blank fields (missing data) and filled by accepted procedures. No additional modifications to the data were made after retrieving them from the EPA's SCRAM web pages.

For ISCST3, the minimum input data requirements to the PCRAMMET are the twice-daily mixing heights and hourly surface observations of wind speed, wind direction, dry bulb temperature, opaque cloud cover and ceiling height. The operations performed by the PCRAMMET include: 1) calculate hourly values for atmospheric stability from meteorological surface observations; and, 2) interpolate twice-daily-mixing heights to hourly values. A brief description of the meteorological data for the two sites is given in Table 2-2.

Table 2-2. Missing soundings and calm wind conditions by site and year.

Site	Year	Anemometer height (feet)	Hours/ year	Missing Soundings		Calm wind conditions
				0000 GMT[11]	1200 GMT	
Pittsburgh	1964	20	8784	0	0	858
Oklahoma City	1984	20	8784	0	0	181

[10] PCRAMMET User's Guide, US EPA, Office of Air Quality Planning and Standards, RTP, NC 27711, EPA-454/B-96-001, October 1996. Available from EPA's Office of Air Quality Planning and Standards Technology Transfer Network world-wide-web site at www.epa.gov/scram001 -- see User's Guides/Related Programs.

[11] GMT = Greenwich Mean Time

2.2 Complex Terrain

The meteorological data base used in the complex terrain portion of this study was taken from a project where on-site data were collected. [12] A 100-m tower, instrumented at 10, 50, and 100 meters and sodar equipment were used to gather the meteorological data. The sodar data was collected at 50-meter intervals, and the 150 -400 meter sodar data were used with the tower data to construct the meteorological profiles. The use of sodar turbulence data was limited to vertical turbulence values only. All of the tower and sodar levels were used in AERMOD and CTDMPLUS runs. Only the 100-m tower data (wind speed and wind direction) was used in ISCST3 runs (see Figure 2-1 for the 100 meter wind rose). The atmospheric turbulence and dispersion for ISCST3 was addressed by applying atmospheric stability classisfications which were estimated by the solar radiation/delta-T (SRDT) stability scheme[13].

To confine the differences between CTDMPLUS and AERMOD to differences in the dispersion algorithms, the METPRO[14] output used for CTDMPLUS (including the boundary layer parameters) was reformatted in a mode compatible with AERMOD meteorological data requirements. However, the predicted concentrations were not sensitive to these boundary layer values because profiled meteorological data were available at several levels straddling the stack release heights.

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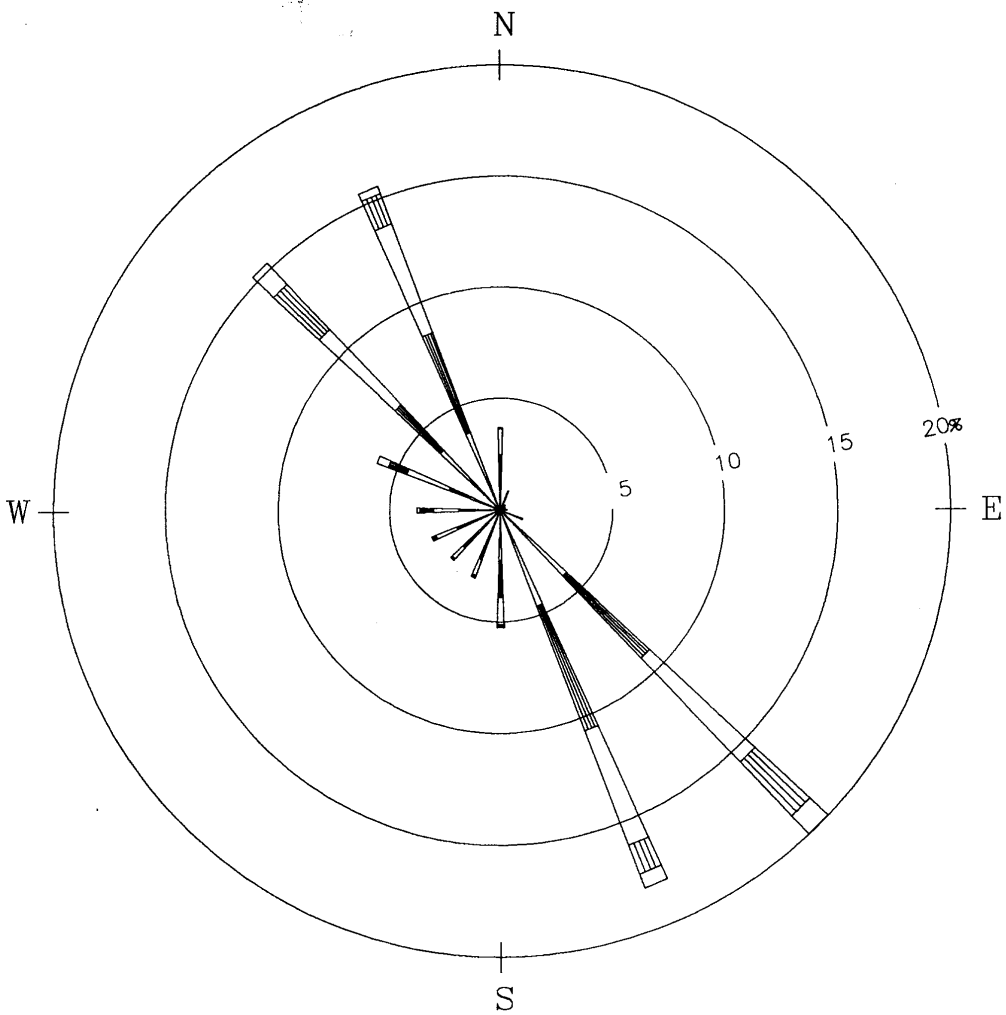
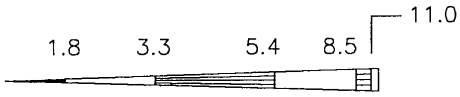
[12] The data came from an unnamed source.

[13] "An Evaluation of A Solar Radiation/Delta-T Method for Estimating Pasquill-Gifford (P-G) Stability Categories", EPA-454/R-93-055, October 1993.

[14] "User's Guide to the CTDM Meteorological Preprocessor Program", EPA-600/8-88-004, 1988.

Wind Rose for 100-m Tower Winds





WIND SPEED CLASS BOUNDARIES
(METERS/SECOND)

NOTES:
DIAGRAM OF THE FREQUENCY OF OCCURRENCE FOR EACH WIND DIRECTION. WIND DIRECTION IS THE DIRECTION FROM WHICH THE WIND IS BLOWING. EXAMPLE – WIND IS BLOWING FROM THE NORTH 3.7 PERCENT OF THE TIME.

WINDROSE

FIGURE 2-1.

3. MODEL OPTIONS AND SOURCE DEFINITIONS

3.1 Modeling Options for Flat, Simple and Complex Terrain.

The regulatory dispersion model used in this study for the flat and simple terrain was ISCST3 model. The model was run in the "regulatory mode" which implies the option settings as described in Table 3-1. Table 3-1 also shows the parallel settings or options used for AERMOD setup.

Table 3-1. Model Options Used in Consequence Analysis

ISCST3	AERMOD
* Use stack tip downwash	* Use stack tip downwash
* Use buoyancy-induced dispersion	* Use buoyancy-induced dispersion (not an option)
* Do not use gradual plume rise (gradual plume rise is used in complex terrain)	* Use gradual plume rise (not an option)
* Use the calms-processing routines	* Use the calms-processing routines(not an option)
* Use default wind profile exponents	* Calculate wind profiles (not an option)
* Use default vertical potential temperature gradients	* Calculate vertical potential temperature gradients (not an option)

As will be seen in the sections displaying the results, both the rural or urban land use settings were applied to all the source configurations.

The averaging periods included in this study were the 1-hr, 3-hr and 24-hr short term averages, plus the period (in this case, the annual) average. Where applicable, the high and the highest second-high concentrations were reported.

3.2 Source Characteristics for Flat, Simple Terrain

Ten sources were processed for the flat terrain part of this study: seven point sources, one area source and two volume sources . Source characteristics for each source type are presented in Table 3-2. For the simple terrain part of this study, the very buoyant 35 meter stack source and the 200 meter stack source in Table 3-2 were used for source configurations. All these sources were evaluated using: 1) both the rural and urban settings; and 2) both sets of meteorological data. Thus, there was a total of 48 cases [(10 flat terrain sources + 2 simple terrain sources) x 2 land use settings x 2 meteorological sites] considered in the non-complex terrain evaluation.

3.3 Source Characteristics for Complex Terrain.

The complex terrain analysis examined a combination of four hills, four source types, and two source-hill distances. The four hills were: 1) Piedmont, a hill near Keyser, WV; 2) Montour Ridge - Crosswind, near Sunbury, PA; 3) Montour Ridge - Alongwind; and 4) Cinder Cone Butte, located near Boise, ID. Except for "Montour Crosswind", the sources were located to the west of the hill centers, at distances of about 1 kilometer for the "close-in" case and about 10 kilometers for the "far-out" case (See Appendix B for the figures describing the hills) . For "Montour Crosswind", the sources were located to the north of the east-west oriented ridge. The meteorological data base used in this study featured a high percentage of winds from the northwest quadrant (see Figure 2-1). Therefore, the modeling results reflect a large number of cases of plume transport from the hypothetical sources to these hills. The source parameters for the complex terrain analysis are provided in Table 3-3. Although there were 32 possible combinations of hill/source/source-hill distances, the plume never significantly impacted the Cinder Cone Butte hill in 4 of the cases and were not included in the analysis. Thus, the results are reported for a total of 28 complex terrain cases.

Table 3-2. Source characteristics for flat and simple terrain.

Point sources					
Stack height (m)	X,Y location & base elevation (m)	Emission rate (gs^{-1})	Exit velocity (ms^{-1})	Stack diameter (m)	Temperature (K)
5	0, 0, 0	100	0	2.4	Ambient
10	0, 0, 0	100	0	2.4	Ambient
20	0, 0, 0	100	0	2.4	Ambient
35 (moderately buoyant)	0, 0, 0	100	11.7	2.4	293
35 (very buoyant)*	0, 0, 0	100	11.7	2.4	432
100	0, 0, 0	100	18.8	4.6	416
200*	0, 0, 0	100	26.5	5.6	425

Area source			
Area (m^2)	Length of side (m)	Emission rate ($gs^{-1}m^{-2}$)	Height of emission release (m)
1,000,000	1000	0.0001	0.0

Volume sources			
Emission rate (gs^{-1})	Height of emision release (m)	Length of side divided by 4.3 (m)	Vertical dimension divided by 4.3 (m)
100	10	14.	16.
100	35	14.	16.

* These sources were used for the simple terrain part of the consequence analysis.

Table 3-3. Complex Terrain Source Configurations.					
Stack height - Buoyancy	Emission rate (g/s)	Stack Height (m)	Stack Gas Temperature (K)	Exit Velocity (m/s)	Stack Diameter (m)
Low/Low	1.0	30.	400.	10.	2.0
Low/High	1.0	30.	500.	30.	6.
High/Low	1.0	150.	400.	10.	2.0
High/High	1.0	150.	500.	30.	6.

3.4 Receptor Configuration for Flat and Simple Terrain

A gridded polar array of receptors was used in the flat terrain portion of the analysis. For the point sources, there were 36 radials (beginning at 10 degrees from north and spaced every 10 degrees). The distance of the concentric rings were: 125m, 250m, 400m, 800m, 2000m, 4000m, 8000m, and 16000m. The volume and the area source polar grid was also set up for 10 degree radials but used concentric ring distances of 125m, 250m, 400m, 800m, and 2000m.

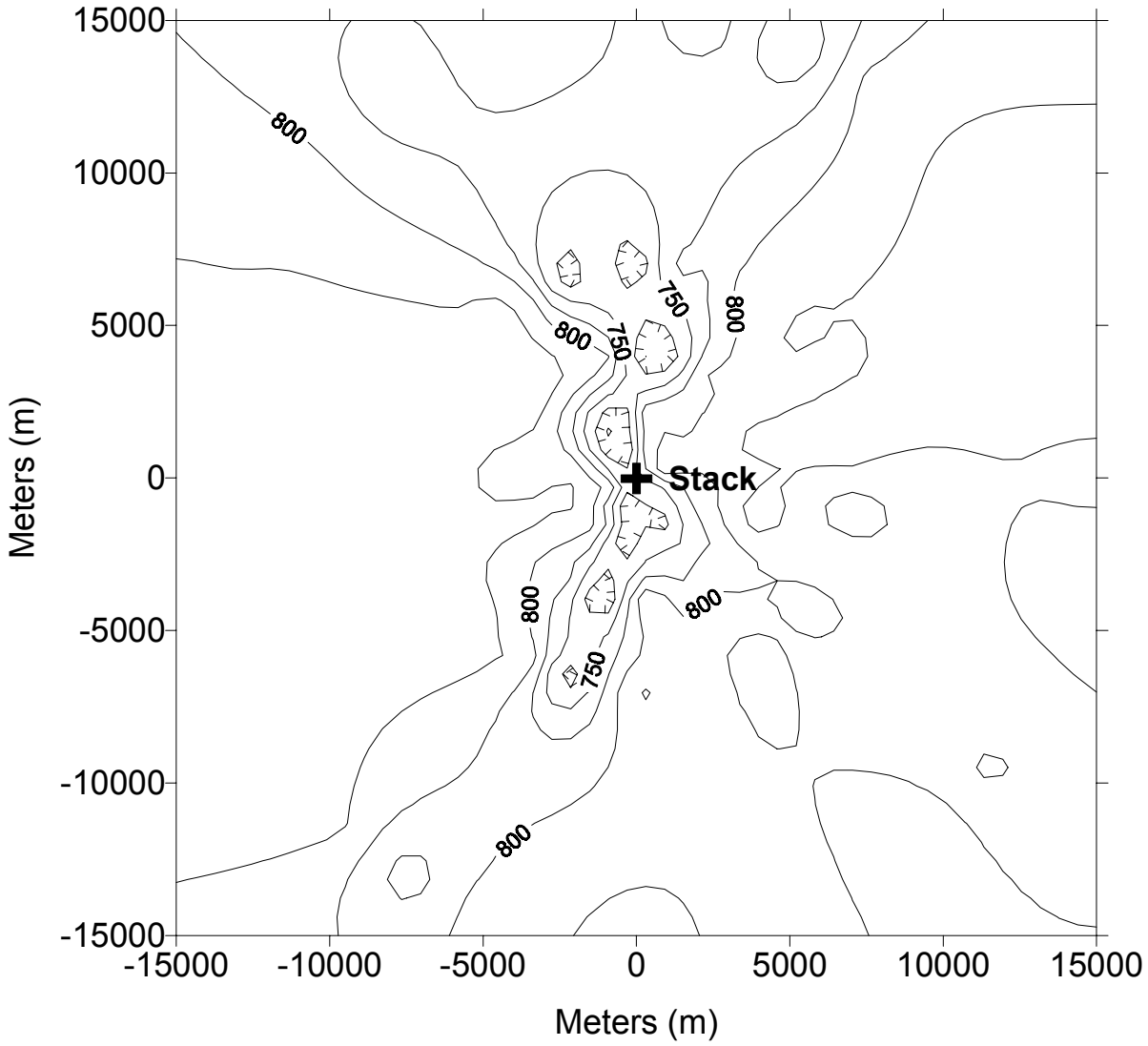
A gridded polar array of receptors was used for the point sources in simple terrain settings. There were 36 radials (beginning at 10 degrees from north and spaced every 10 degrees). The distance of the concentric rings were: 800m, 2000m, 4000m, 7000m, and 15000m. The elevations for the receptors are plotted (with isopleths) in Figures 3-1 (35 meter stack) and 3-2 (200 meter stack).

3.5 The Complex Terrain Receptor Locations.

The Figures in Appendix B show the contours of the hills used in the analysis. AERMOD, ISCST3, and CTDMPLUS were run with the full year of data described above for 28 combinations

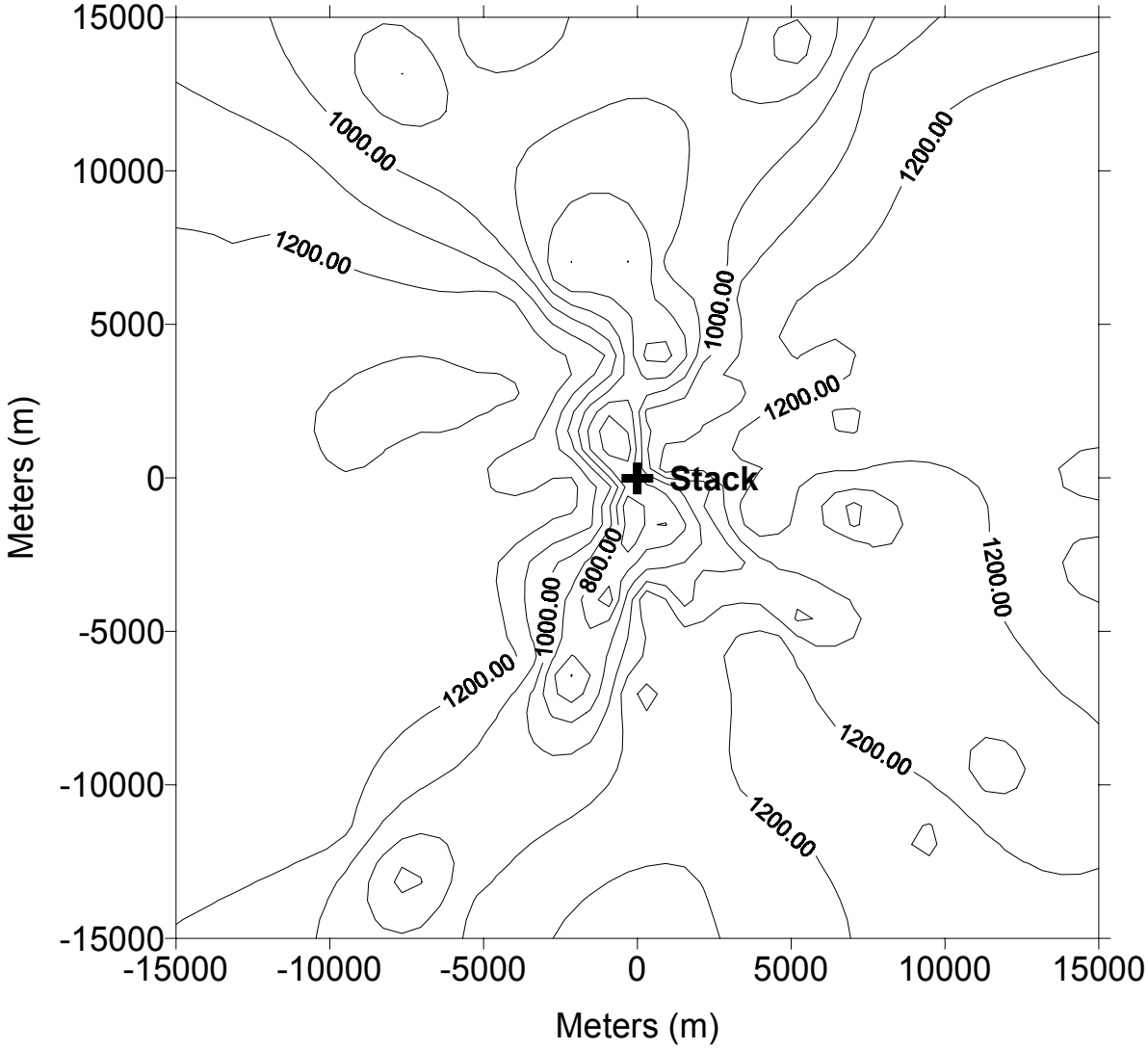
of hills, sources, and source-hill distances. For CCB and Montour Alongwind/Crosswind, a total of

Figure 3-1
Elevation in Feet Around the 35 Meter Stack



Note: 25 ft. contours

Figure 3-2
Elevation in Feet Around the 200 Meter Stack



Note: 100 ft. contours

140 receptors was used; for Piedmont Hill, a total of 144 receptors was used. Appendix C contains the input files used to run AERMOD and provides the location and elevations of all the receptor locations for all runs. In all cases, each model estimated concentrations on single hills downwind from the source.

4. MODELING RESULTS

4.1 The Flat and Simple Terrain Results.

The highest second high (H2H) ratios for the 1, 3 and 24 hour averaging times, which compare AERMOD to ISCST3 concentrations in flat and simple terrain, are graphically presented in Figures 4-1 through 4-10. For coverage of all averaging times of interest, the highest annual concentrations are included in the figures. The more detailed modeling results (both high and highest 2nd high concentrations) are listed in Appendix D.

4.2 The Complex Terrain Results.

The complex terrain results which compare AERMOD to ISCST3[15] and to CTDMPLUS, are graphically presented in Figures 4-11 though 4-18. As in the flat terrain cases, the highest second high ratios along with the highest annual concentrations are included in the the figures. The more detailed modeling results (both high and highest 2nd high concentrations) are listed in Appendix E.

The comparison presented here consists of taking the highest and second-highest 1-hour, 3-hour, and 24-hour concentration over all receptors from each model. Tabulations of these results and ratios of AERMOD to CTDMPLUS concentrations are presented in Figures 4-9 through 4-16 for the various source and source-hill distance combinations. The code for each scenario evaluated is as follows: The first 2 letters refer to the name of the hill: PH = Piedmont, MC = Montour Crosswind, MA = Montour Alongwind, CC = Cinder Cone Butte. The 3rd letter refers to the stack height: L = 30 meters, H = 150m. The fourth letter refers to the buoyancy: L = low, H = high. The fifth letter stands for the distance between the source and the hill: C = close or 1 kilometer, F = far or 10 km.

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[15] In complex terrain, the COMPLEX1 portion of the ISCST3 model is playing a significant role. For receptors with elevations above the plume height, the COMPLEX1 concentration estimates are used. In intermediate terrain, the highest estimates from the "ISCST3" simple terrain model and the COMPLEX1 model are used.

FIGURE 4-1. RATIOS OF HIGH-SECOND HIGH (PLUS HIGH ANNUAL) CONCENTRATIONS RURAL, SHORT STACKS, NON-BUOYANT PLUME, FLAT TERRAIN

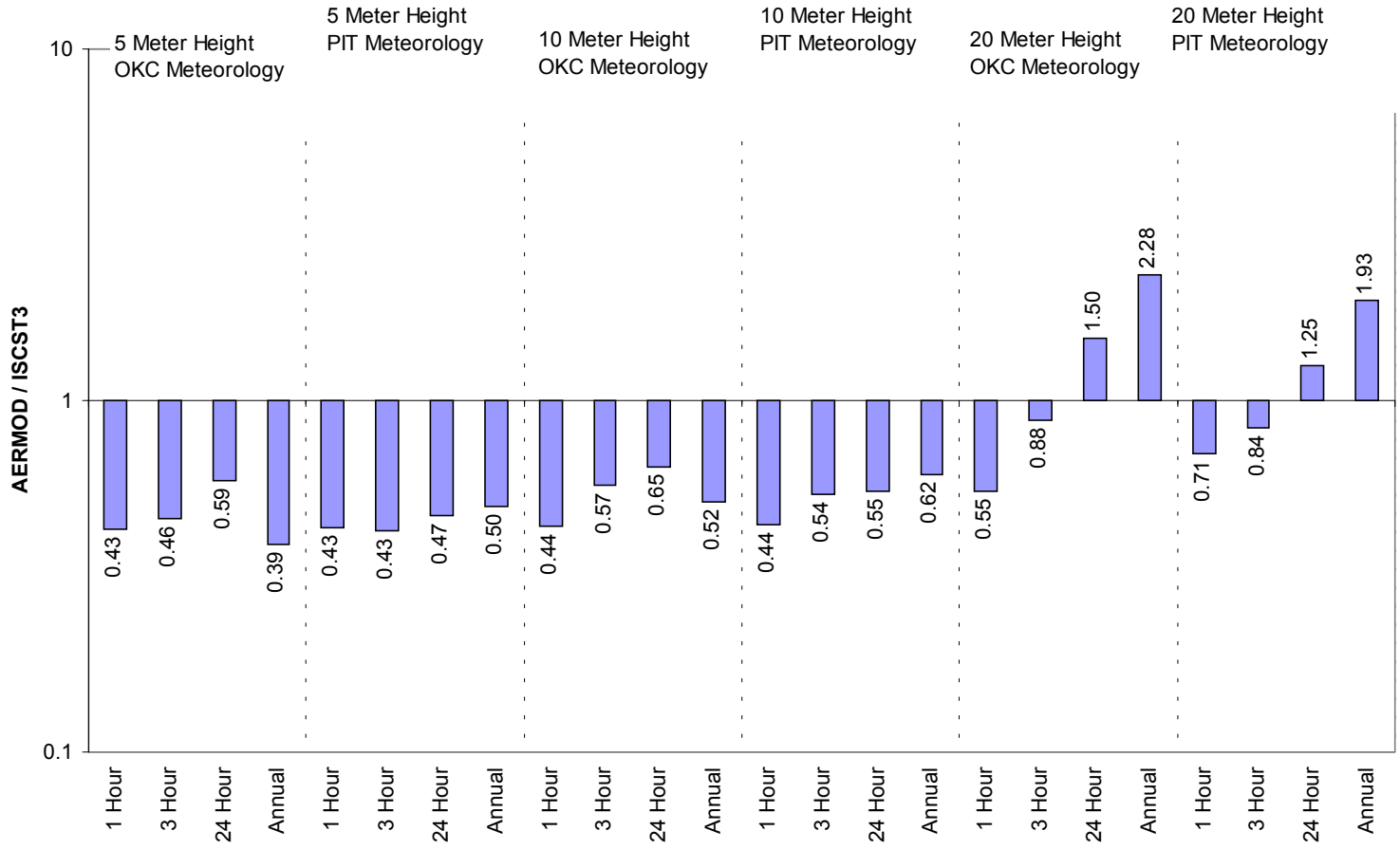


FIGURE 4-2. RATIOS OF HIGH-SECOND HIGH (PLUS HIGH ANNUAL) CONCENTRATIONS RURAL, MEDIUM AND TALL STACKS, VERY BUOYANT, FLAT TERRAIN

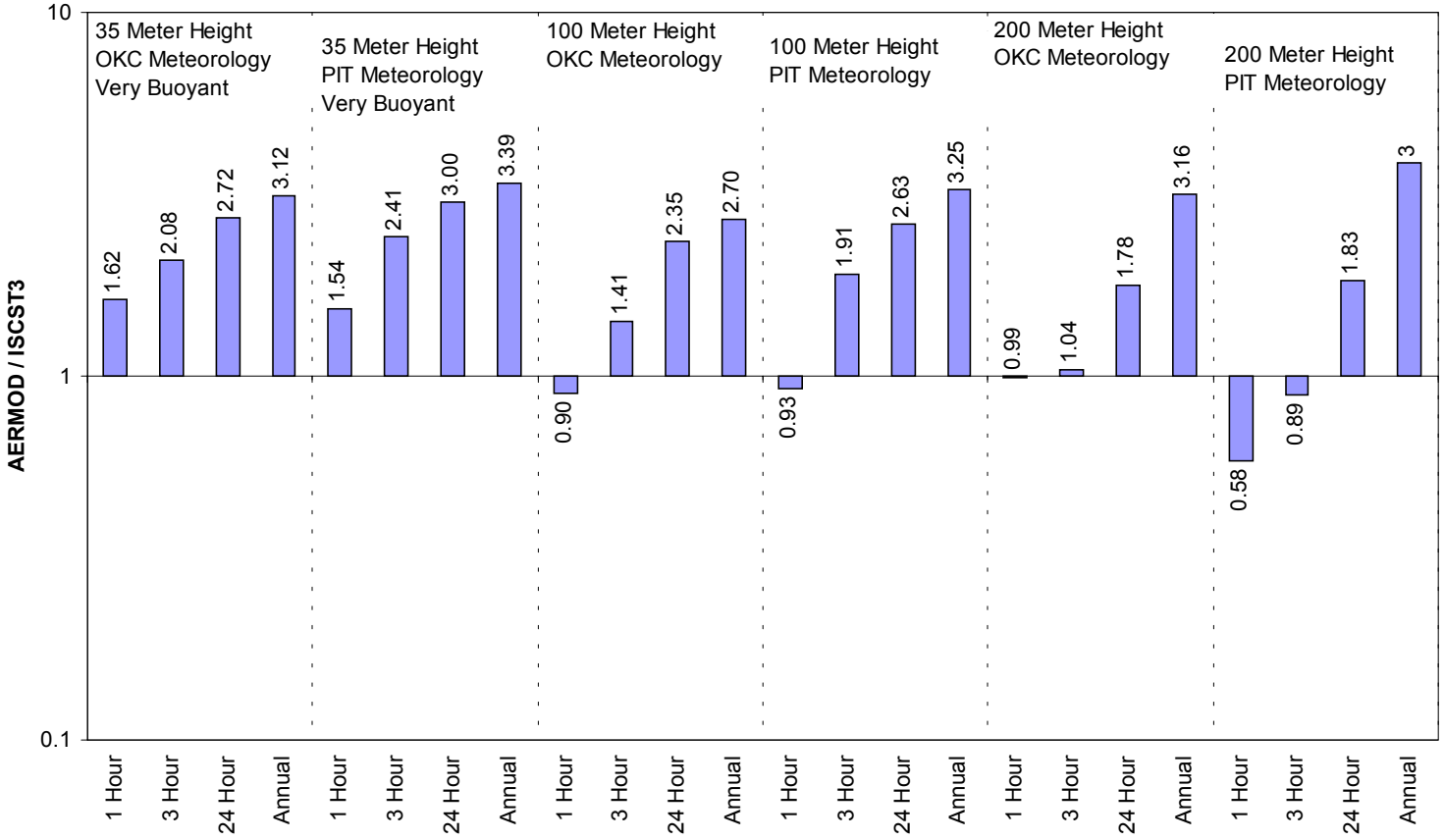


FIGURE 4-3. RATIOS OF HIGH-SECOND HIGH (PLUS HIGH ANNUAL) CONCENTRATIONS RURAL, BUOYANT PLUME, SIMPLE TERRAIN

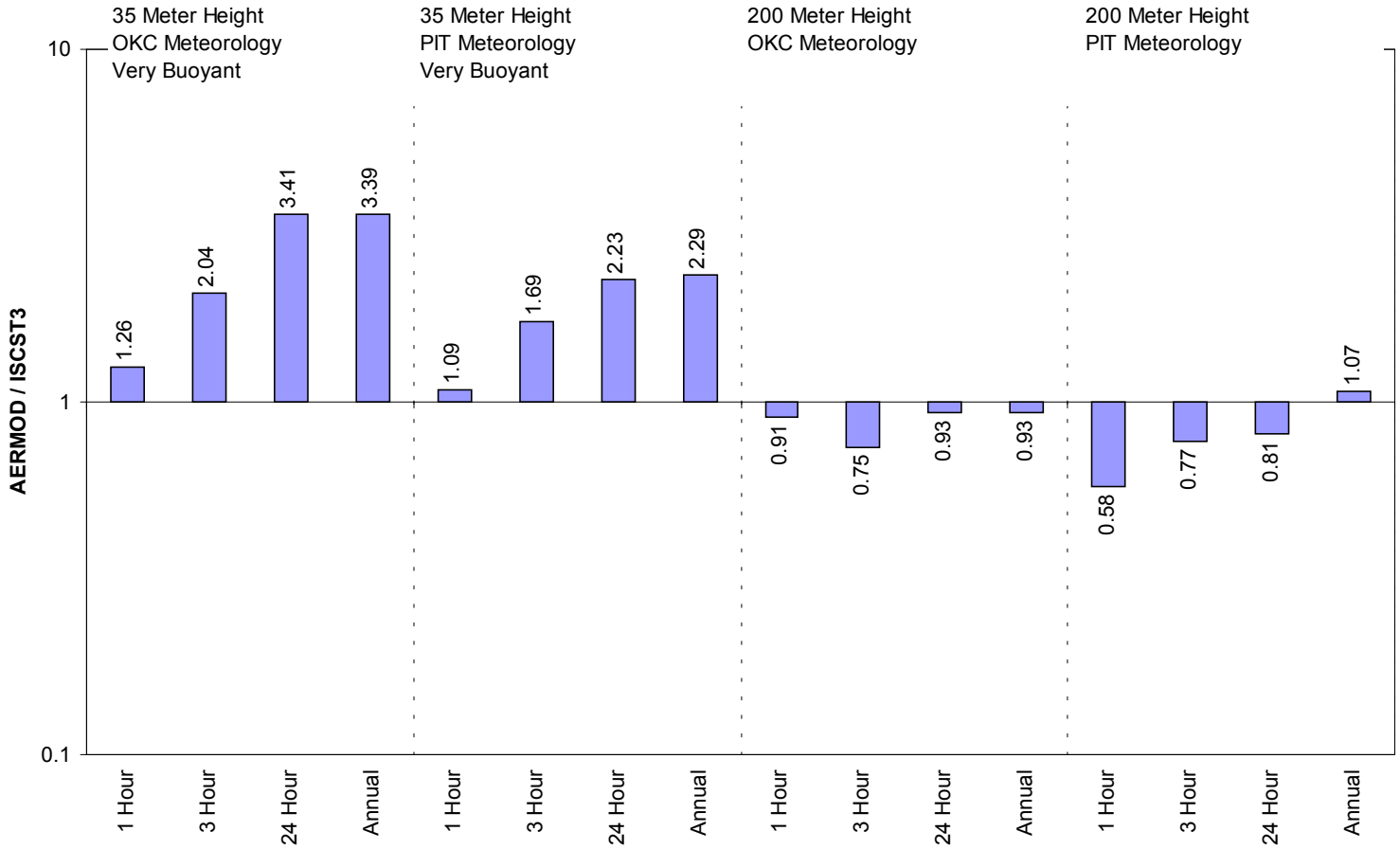


FIGURE 4-4. RATIOS OF HIGH-SECOND HIGH (PLUS HIGH ANNUAL) CONCENTRATIONS RURAL, ALL 35 METER STACK CASES

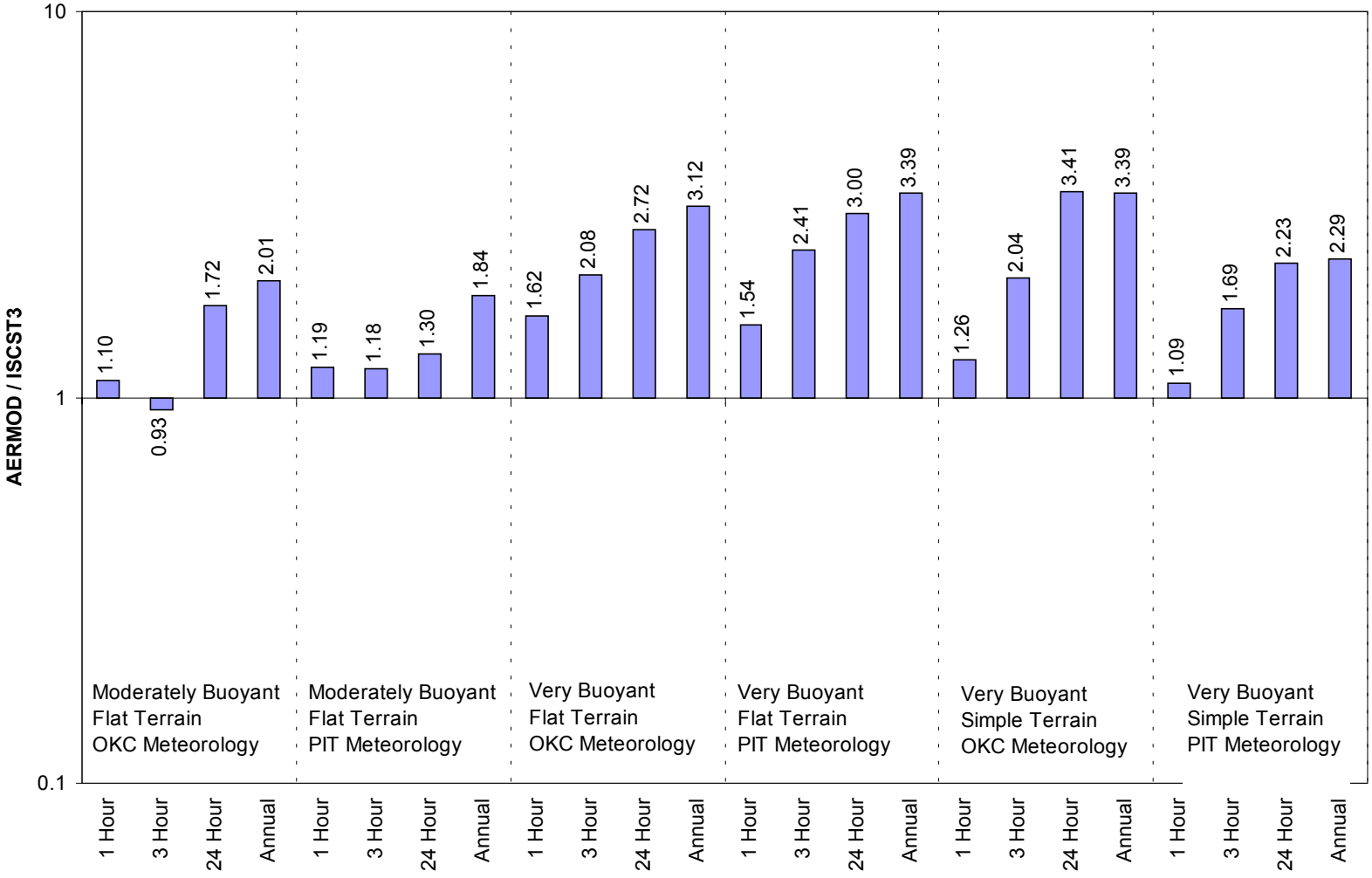


FIGURE 4-5. RATIOS OF HIGH-SECOND HIGH (PLUS HIGH ANNUAL) CONCENTRATIONS RURAL, VOLUME AND AREA SOURCES, FLAT TERRAIN

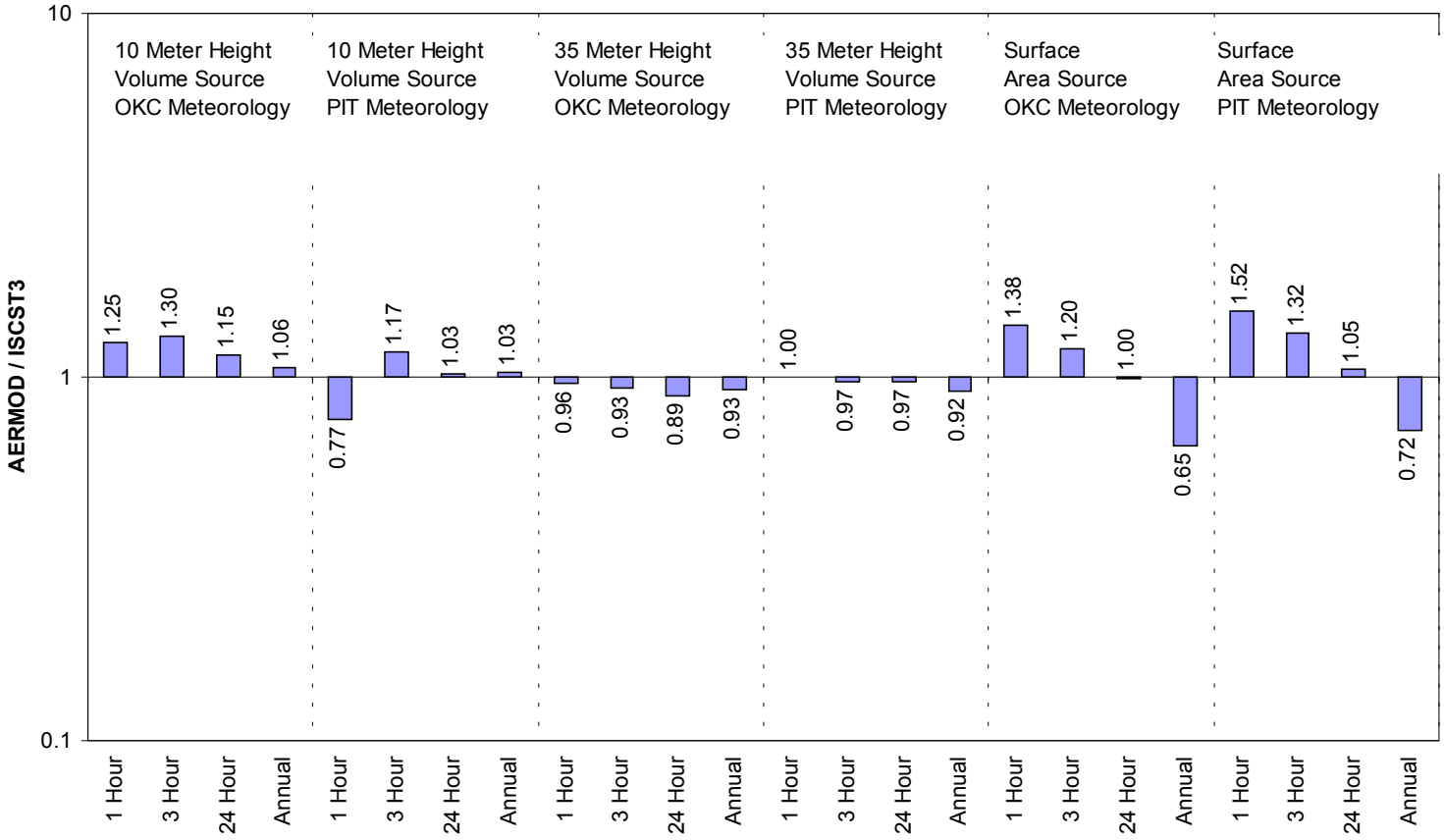


FIGURE 4-6. RATIOS OF HIGH-SECOND HIGH (PLUS HIGH ANNUAL) CONCENTRATIONS URBAN, SHORT STACKS, NON-BUOYANT PLUME, FLAT TERRAIN

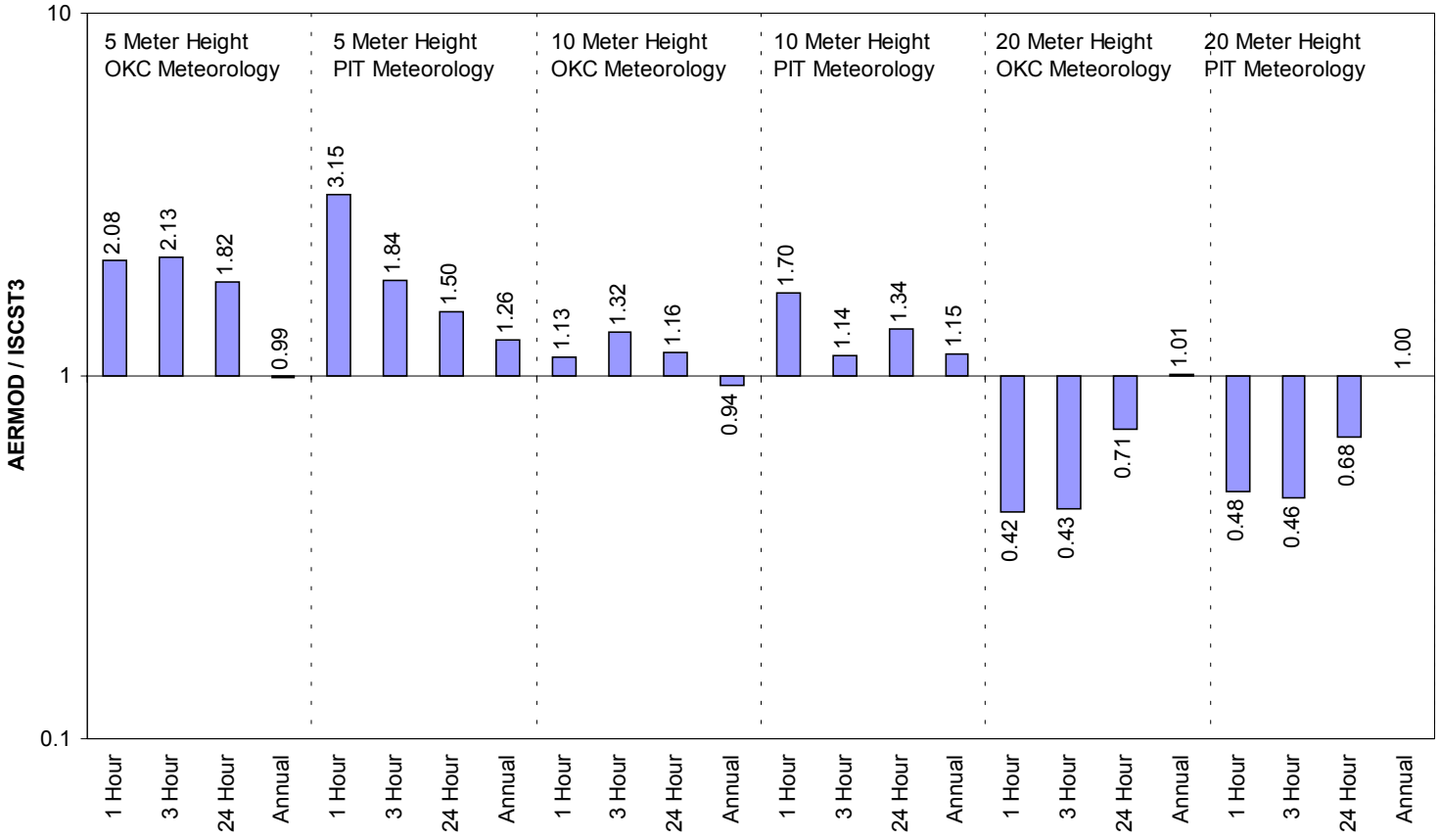


FIGURE 4-7. RATIOS OF HIGH-SECOND HIGH (PLUS HIGH ANNUAL) CONCENTRATIONS URBAN, MEDIUM , TALL STACKS, VERY BUOYANT PLUME, FLAT TERRAIN

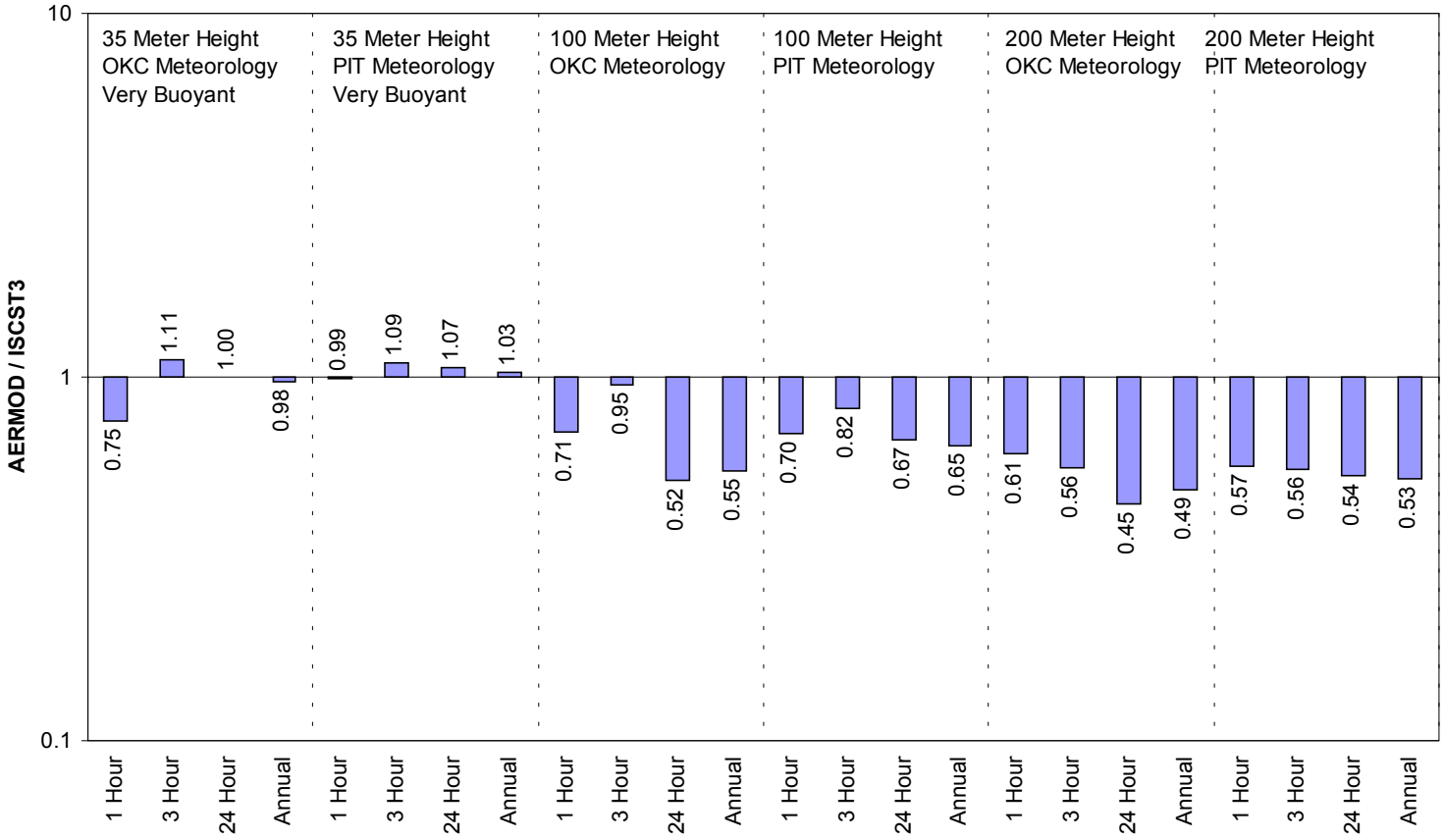


FIGURE 4-8. RATIOS OF HIGH-SECOND HIGH (PLUS HIGH ANNUAL) CONCENTRATIONS URBAN, BUOYANT PLUME, SIMPLE TERRAIN

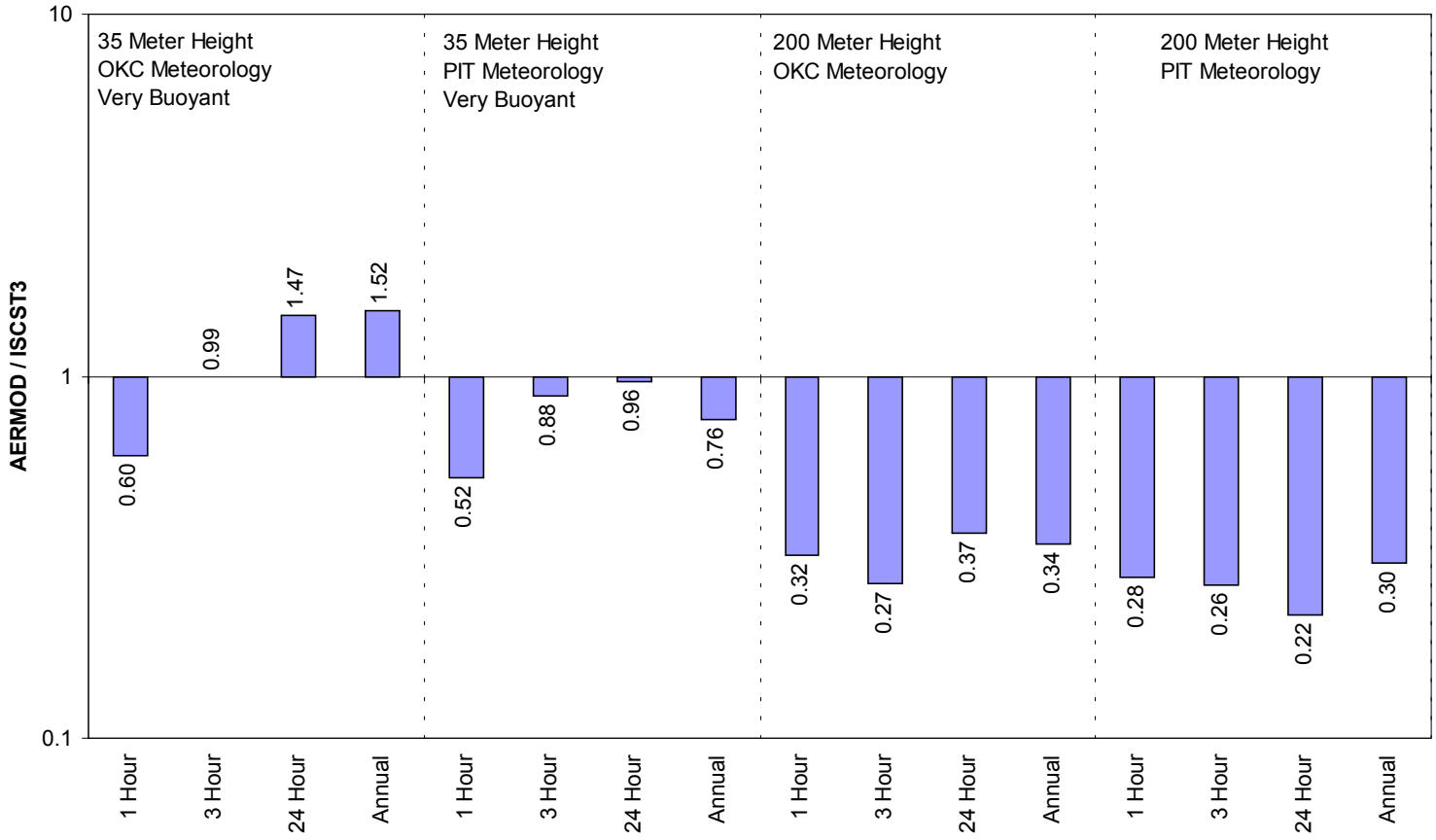


FIGURE 4-9. RATIOS OF HIGH-SECOND HIGH (PLUS HIGH ANNUAL) CONCENTRATIONS URBAN, ALL 35 METER STACK CASES

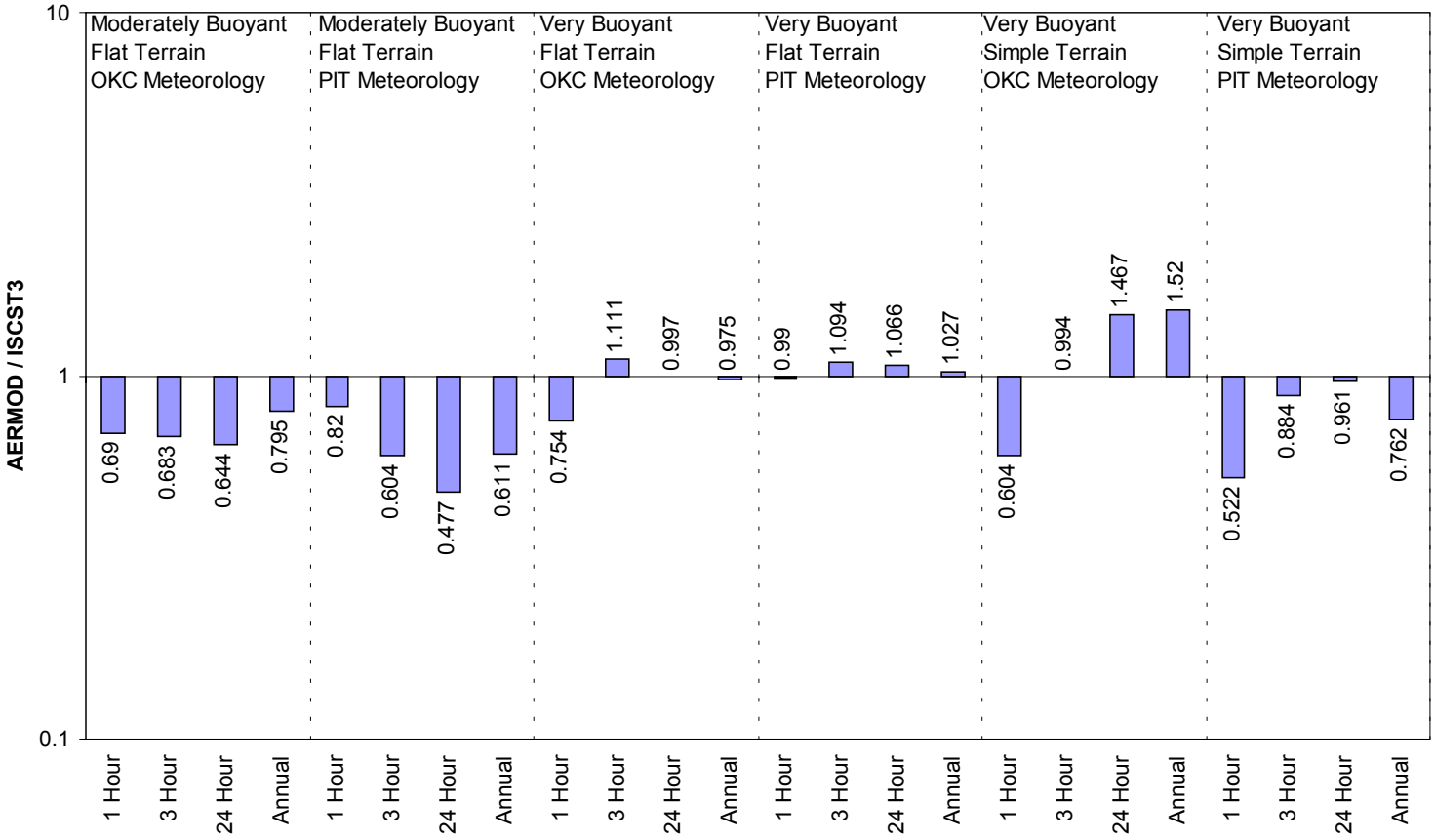


FIGURE 4-10. RATIOS OF HIGH-SECOND HIGH (PLUS HIGH ANNUAL) CONCENTRATIONS URBAN, VOLUME AND AREA SOURCES, FLAT TERRAIN

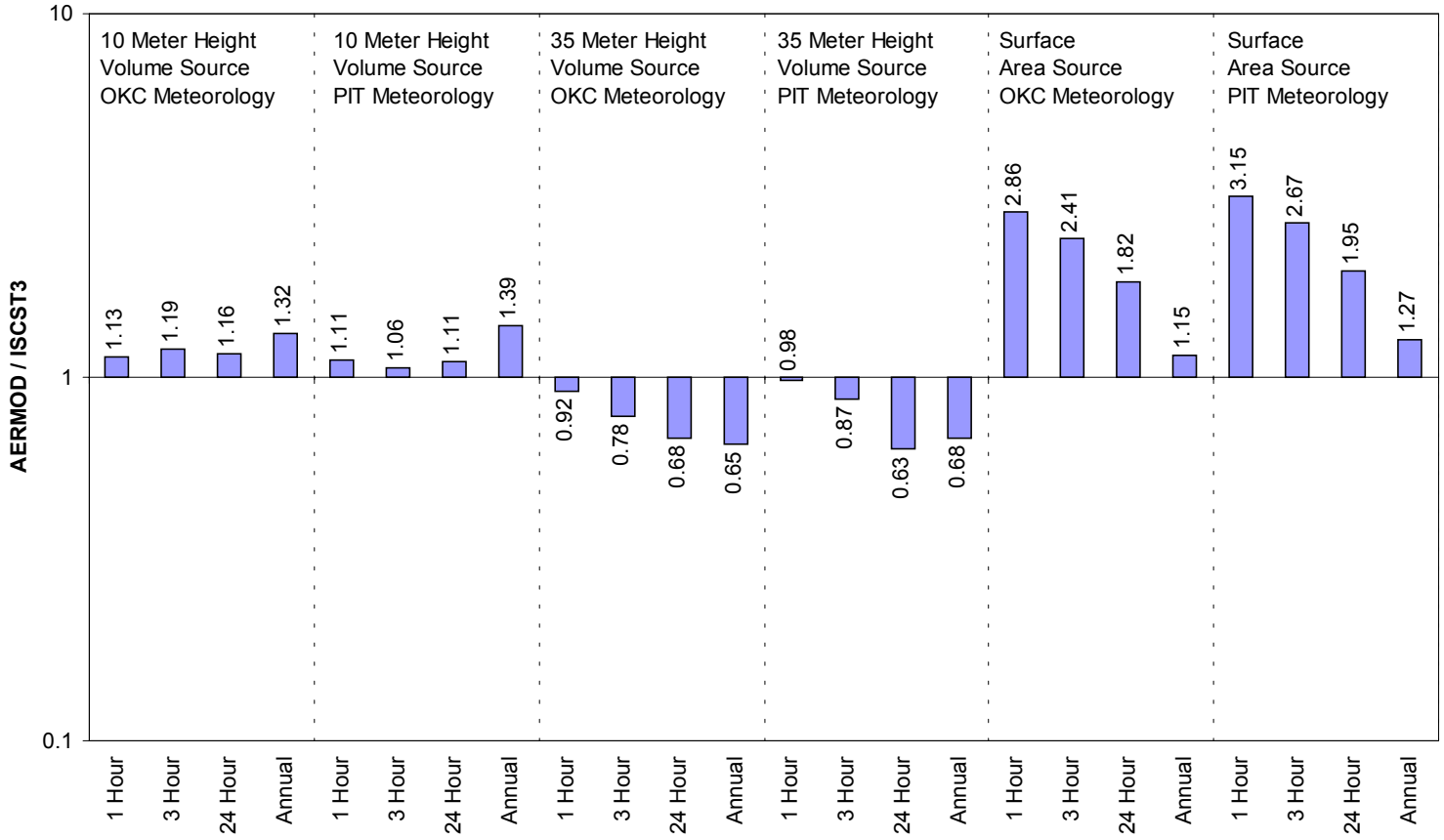
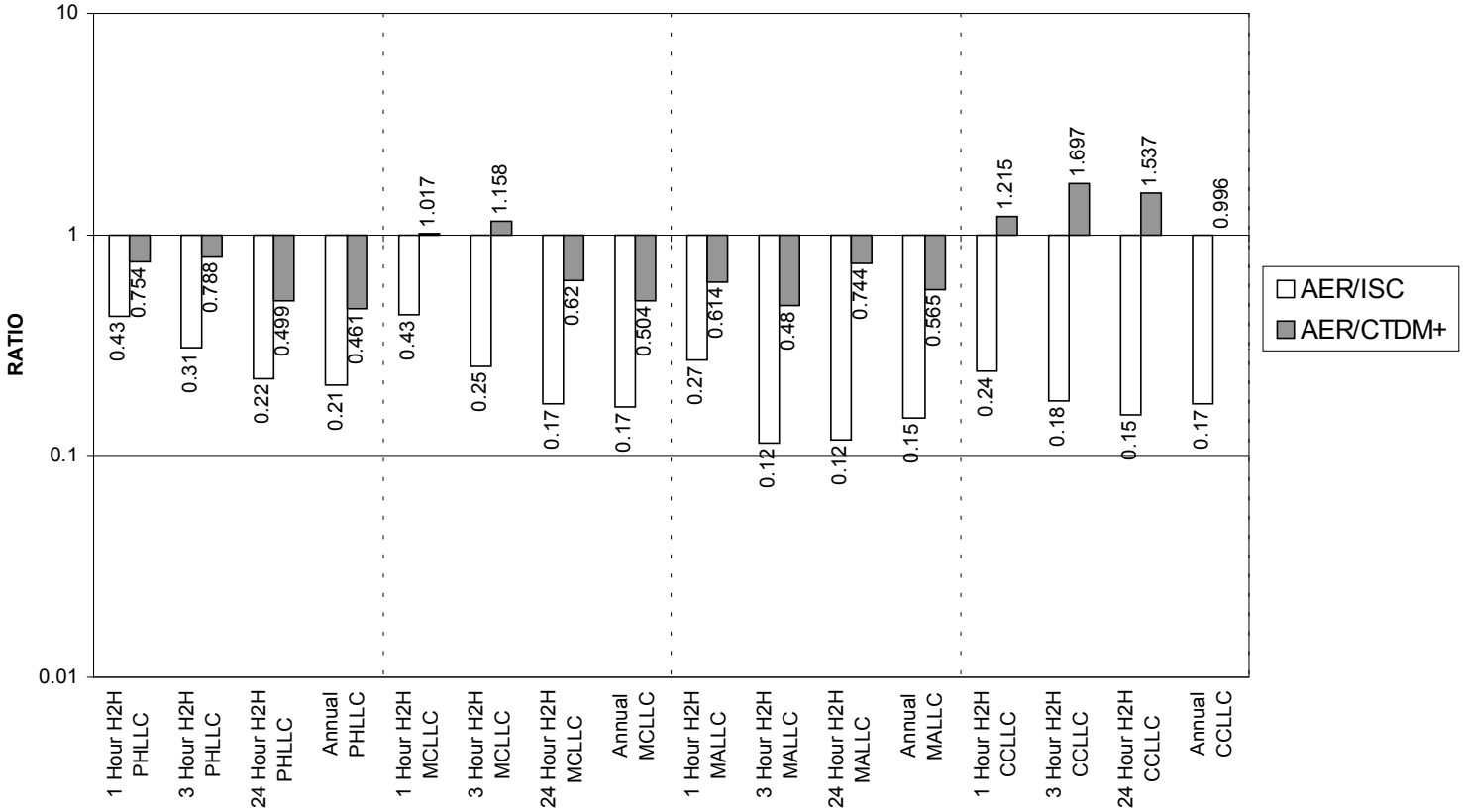
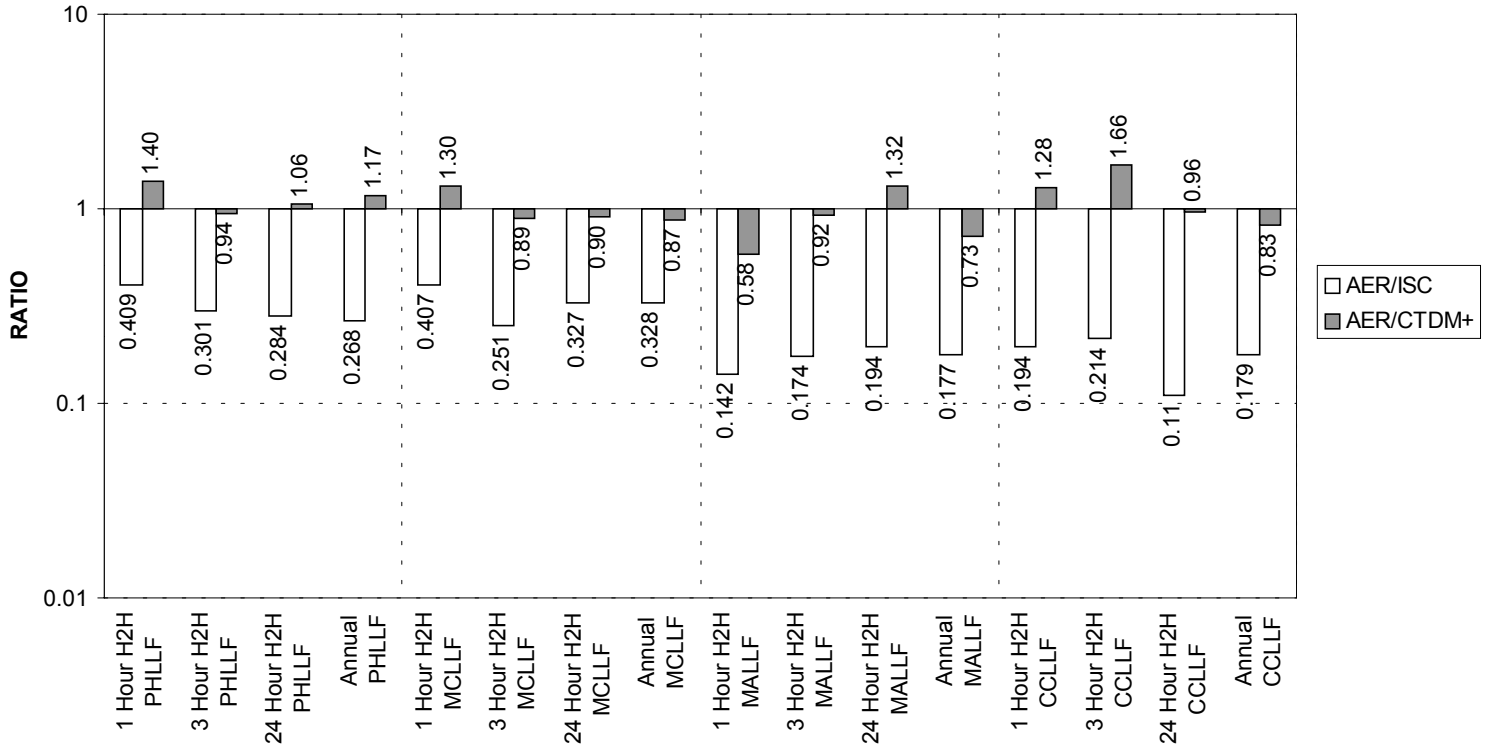


FIGURE 4-11
RATIOS OF HIGH-SECOND HIGH (PLUS HIGH ANNUAL) CONCENTRATIONS
AERMOD TO ISCST3(COMPLEX1) AND CTDMPLUS
COMPLEX TERRAIN
LOW STACK, LOW BUOYANCY, HILL CLOSE TO SOURCE



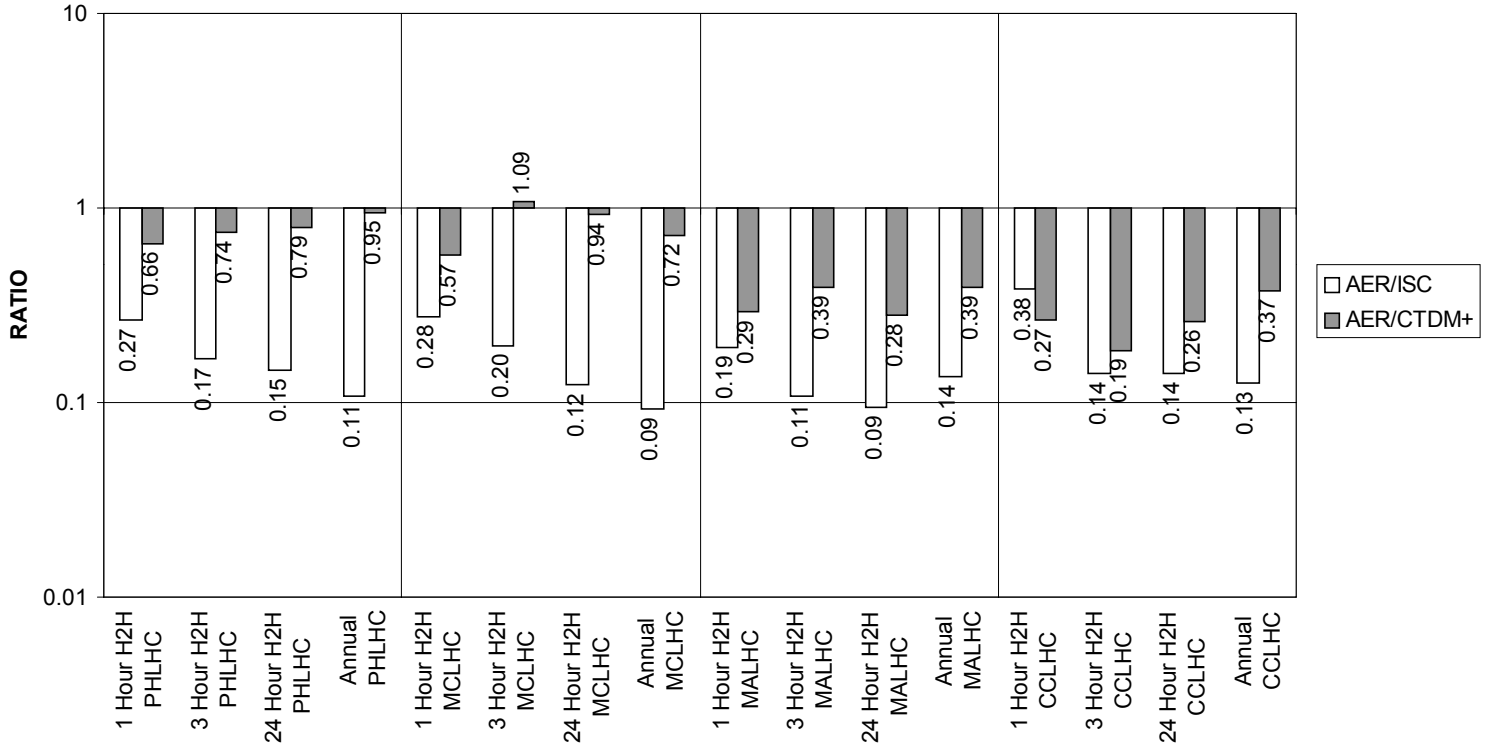
The code for each scenario evaluated is as follows: The first 2 letters refer to the name of the hill: PH = Piedmont, MC = Montour Crosswind, MA = Montour Alongwind, CC = Cinder Cone Butte. The 3rd letter refers to the stack height: L = 30 meters, H = 150m. The fourth letter refers to the buoyancy: L = low, H = high. The fifth letter stands for the distance between the source and the hill: C = close or 1 kilometer, F = far or 10 km.

FIGURE 4-12.
RATIOS OF HIGH-SECOND HIGH (PLUS HIGH ANNUAL) CONCENTRATIONS
AERMOD TO ISCST3(COMPLEX1) AND CTDMPLUS
COMPLEX TERRAIN
LOW STACK, LOW BUOYANCY, HILL FAR FROM SOURCE



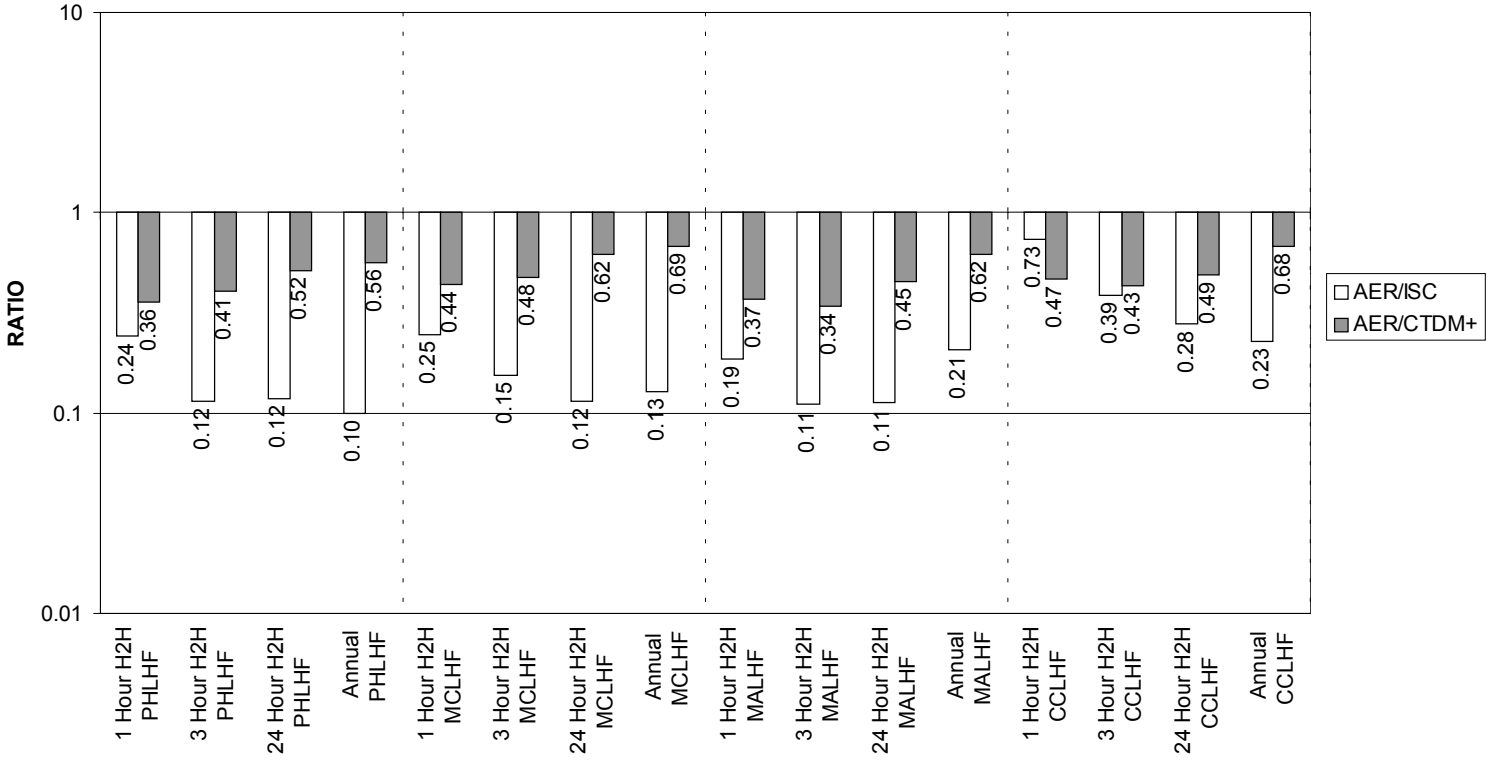
The code for each scenario evaluated is as follows: The first 2 letters refer to the name of the hill: PH = Piedmont, MC = Montour Crosswind, MA = Montour Alongwind, CC = Cinder Cone Butte. The 3rd letter refers to the stack height: L = 30 meters, H = 150m. The fourth letter refers to the buoyancy: L = low, H = high. The fifth letter stands for the distance between the source and the hill: C = close or 1 kilometer, F = far or 10 km.

FIGURE 4-13.
RATIOS OF HIGH-SECOND HIGH (PLUS HIGH ANNUAL) CONCENTRATIONS
AERMOD TO ISCST3(COMPLEX1) AND CTDMPLUS
COMPLEX TERRAIN
LOW STACK, HIGH BUOYANCY, HILL CLOSE TO SOURCE



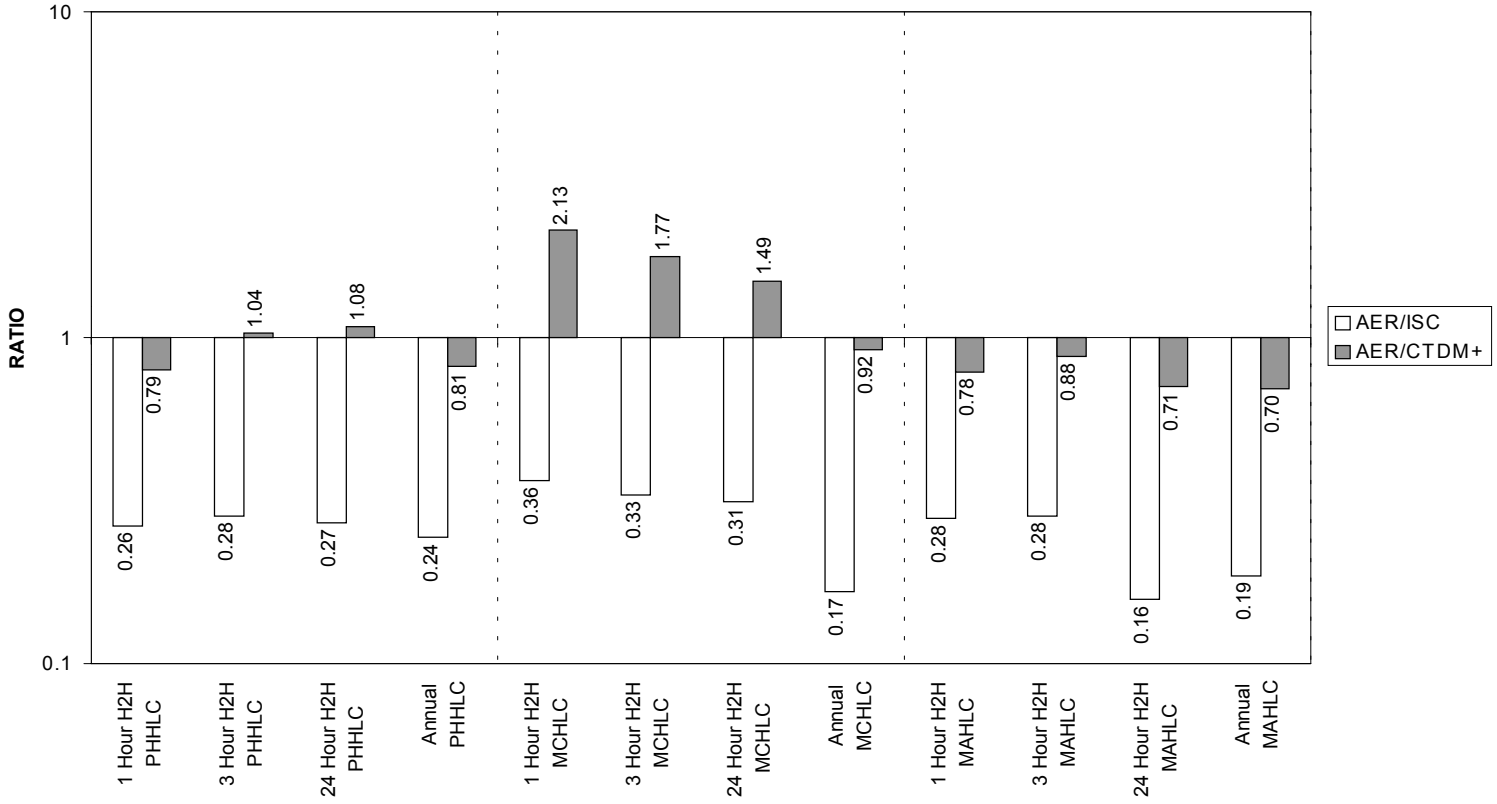
The code for each scenario evaluated is as follows: The first 2 letters refer to the name of the hill: PH = Piedmont, MC = Montour Crosswind, MA = Montour Alongwind, CC = Cinder Cone Butte. The 3rd letter refers to the stack height: L = 30 meters, H = 150m. The fourth letter refers to the buoyancy: L = low, H = high. The fifth letter stands for the distance between the source and the hill: C = close or 1 kilometer, F = far or 10 km.

FIGURE 4-14.
RATIOS OF HIGH-SECOND HIGH (PLUS HIGH ANNUAL) CONCENTRATIONS
AERMOD TO ISCST3(COMPLEX1) AND CTDMPLUS
COMPLEX TERRAIN
LOW STACK, HIGH BUOYANCY, HILL FAR FROM SOURCE



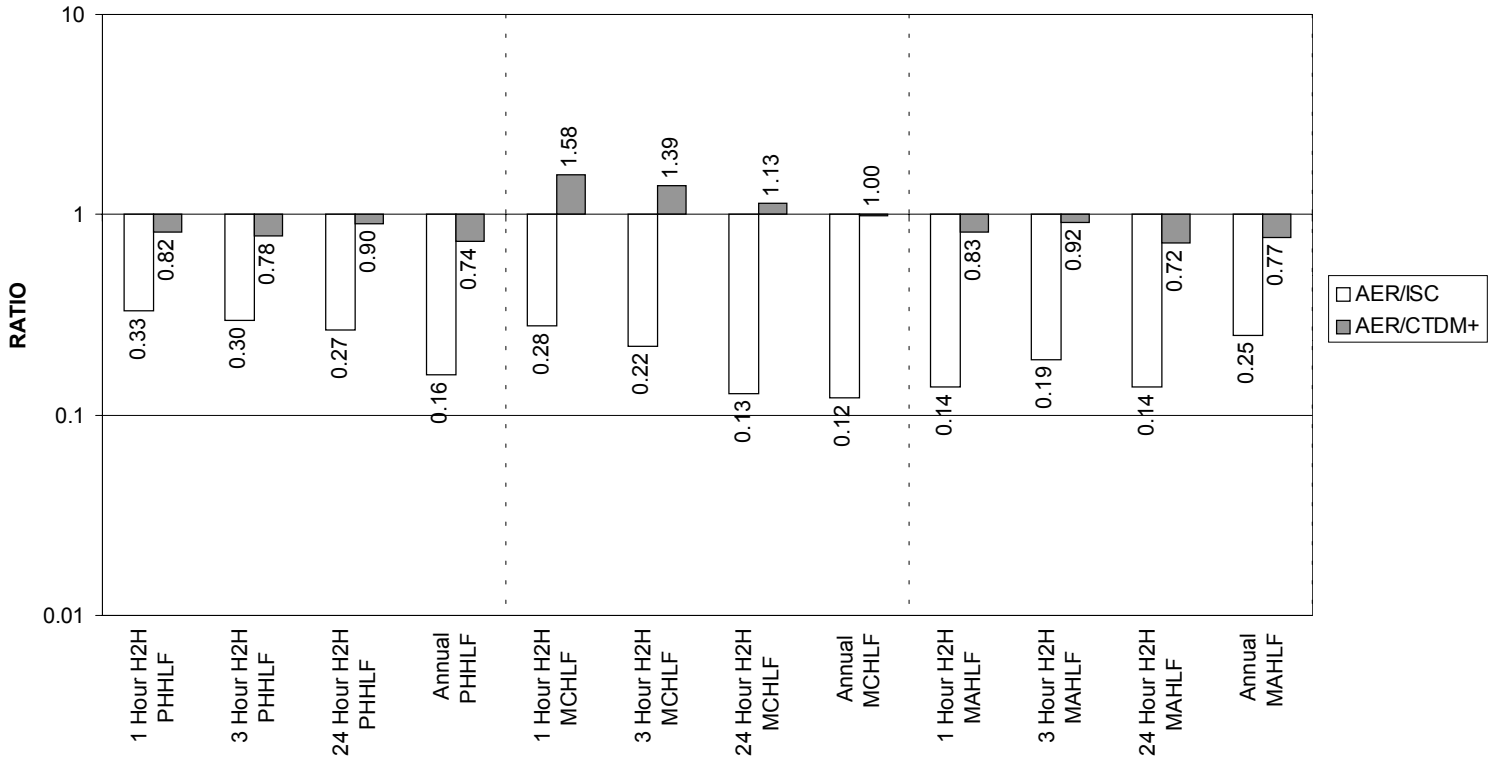
The code for each scenario evaluated is as follows: The first 2 letters refer to the name of the hill: PH = Piedmont, MC = Montour Crosswind, MA = Montour Alongwind, CC = Cinder Cone Butte. The 3rd letter refers to the stack height: L = 30 meters, H = 150m. The fourth letter refers to the buoyancy: L = low, H = high. The fifth letter stands for the distance between the source and the hill: C = close or 1 kilometer, F = far or 10 km.

FIGURE 4-15.
RATIOS OF HIGH-SECOND HIGH (PLUS HIGH ANNUAL) CONCENTRATIONS
AERMOD TO ISCST3(COMPLEX1) AND CTDMPLUS
COMPLEX TERRAIN
HIGH STACK, LOW BUOYANCY, HILL CLOSE TO SOURCE



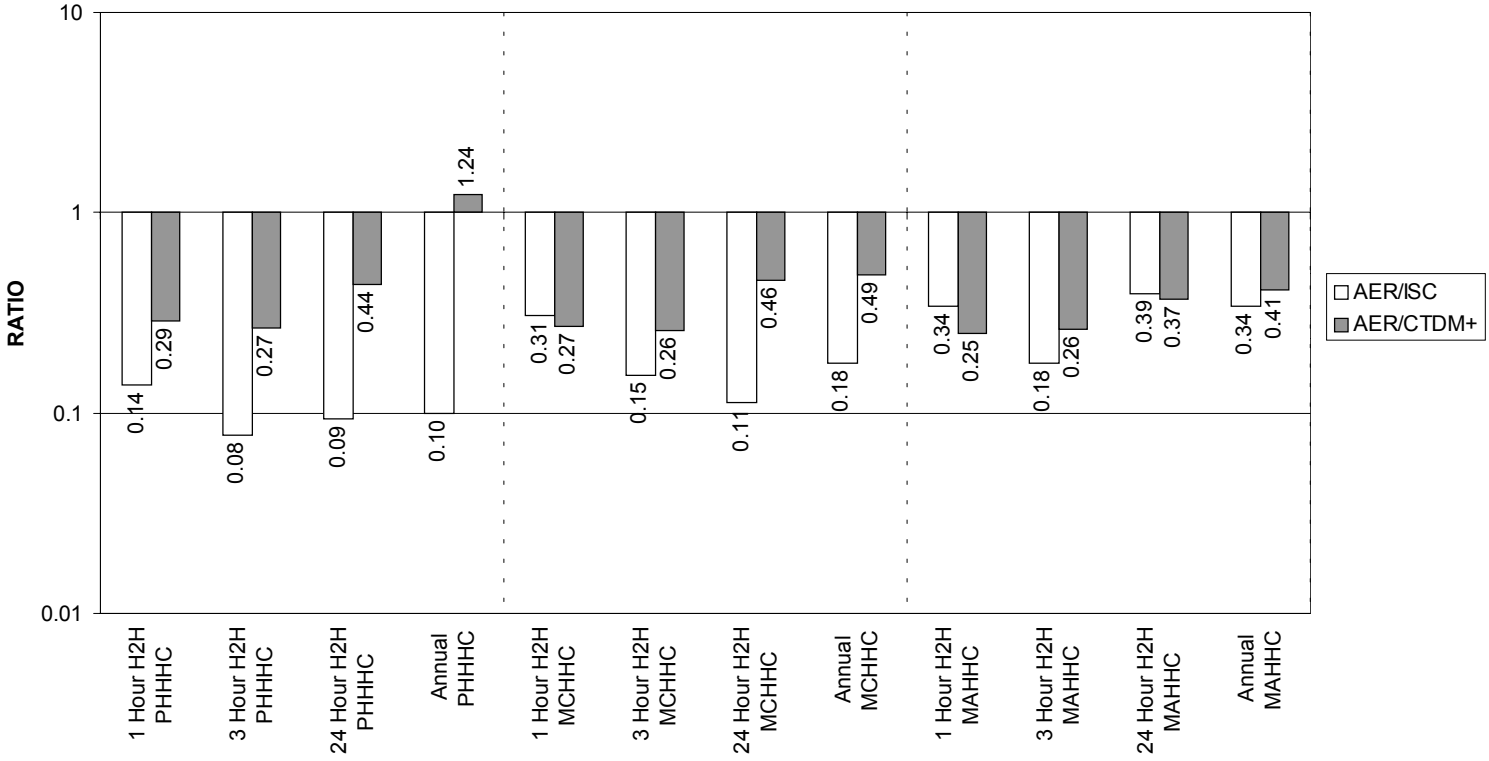
The code for each scenario evaluated is as follows: The first 2 letters refer to the name of the hill: PH = Piedmont, MC = Montour Crosswind, MA = Montour Alongwind, CC = Cinder Cone Butte. The 3rd letter refers to the stack height: L = 30 meters, H = 150m. The fourth letter refers to the buoyancy: L = low, H = high. The fifth letter stands for the distance between the source and the hill: C = close or 1 kilometer, F = far or 10 km.

FIGURE 4-16.
RATIOS OF HIGH-SECOND HIGH (PLUS HIGH ANNUAL) CONCENTRATIONS
AERMOD TO ISCST3(COMPLEX1) AND CTDMPLUS
COMPLEX TERRAIN
HIGH STACK, LOW BUOYANCY, HILL FAR FROM SOURCE



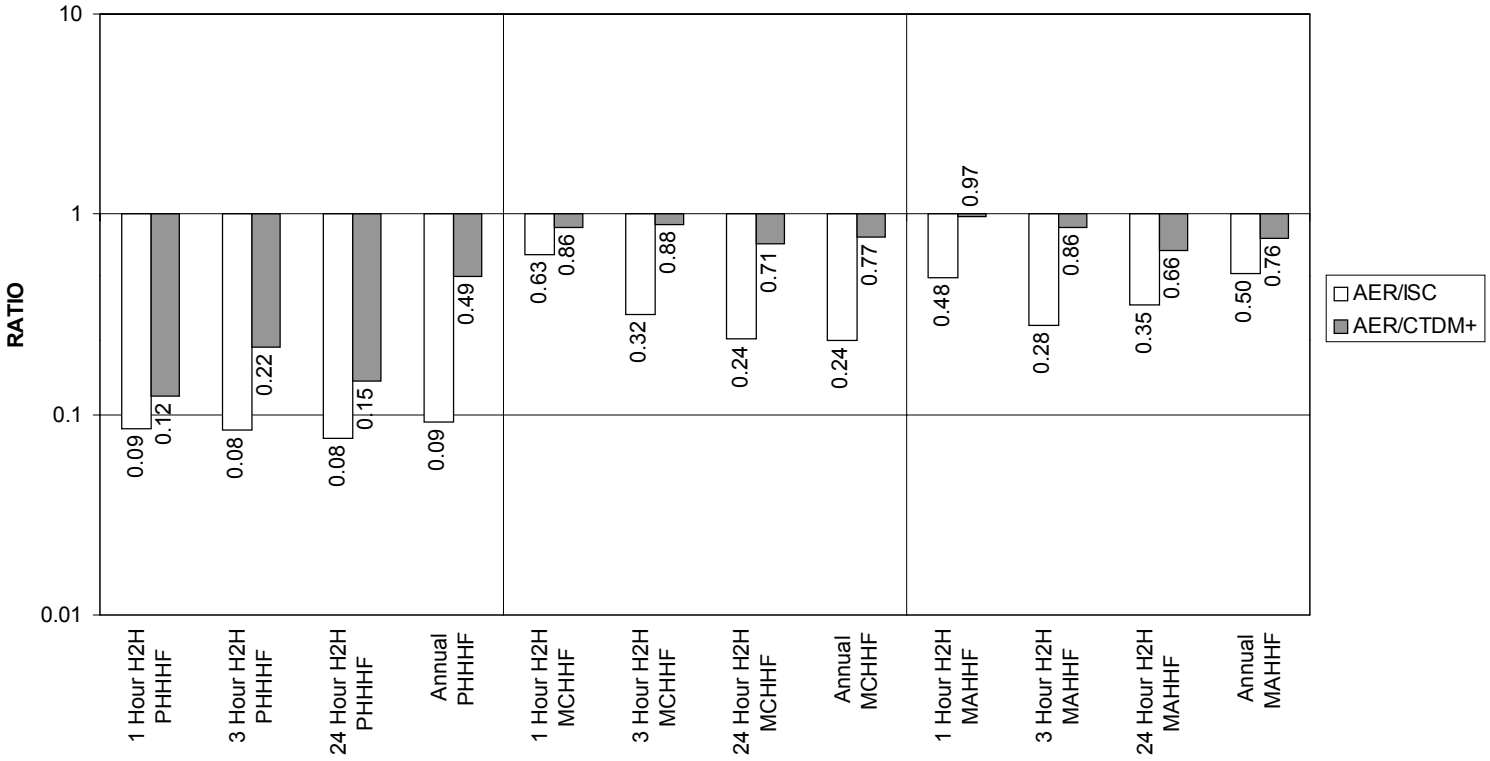
The code for each scenario evaluated is as follows: The first 2 letters refer to the name of the hill: PH = Piedmont, MC = Montour Crosswind, MA = Montour Alongwind, CC = Cinder Cone Butte. The 3rd letter refers to the stack height: L = 30 meters, H = 150m. The fourth letter refers to the buoyancy: L = low, H = high. The fifth letter stands for the distance between the source and the hill: C = close or 1 kilometer, F = far or 10 km.

FIGURE 4-17.
RATIOS OF HIGH-SECOND HIGH (PLUS HIGH ANNUAL) CONCENTRATIONS
AERMOD TO ISCST3(COMPLEX1) AND CTDMPLUS
COMPLEX TERRAIN
HIGH STACK, HIGH BUOYANCY, HILL CLOSE TO SOURCE



The code for each scenario evaluated is as follows: The first 2 letters refer to the name of the hill: PH = Piedmont, MC = Montour Crosswind, MA = Montour Alongwind, CC = Cinder Cone Butte. The 3rd letter refers to the stack height: L = 30 meters, H = 150m. The fourth letter refers to the buoyancy: L = low, H = high. The fifth letter stands for the distance between the source and the hill: C = close or 1 kilometer, F = far or 10 km.

FIGURE 4-18.
RATIOS OF HIGH-SECOND HIGH (PLUS HIGH ANNUAL) CONCENTRATIONS
AERMOD TO ISCST3(COMPLEX1) AND CTDMPLUS
COMPLEX TERRAIN
HIGH STACK, HIGH BUOYANCY, HILL FAR FROM SOURCE



The code for each scenario evaluated is as follows: The first 2 letters refer to the name of the hill: PH = Piedmont, MC = Montour Crosswind, MA = Montour Alongwind, CC = Cinder Cone Butte. The 3rd letter refers to the stack height: L = 30 meters, H = 150m. The fourth letter refers to the buoyancy: L = low, H = high. The fifth letter stands for the distance between the source and the hill: C = close or 1 kilometer, F = far or 10 km.

5. SUMMARY AND DISCUSSION OF RESULTS

5.1 Summary Tables.

Because of the amount of data and complexity of the tables in the earlier section of the report, another table, Table 5-1, was created to present summary statistics on the relationship between the predicted concentrations from AERMOD and ISCST3 for the flat and simple terrain scenarios.

Table 5-1. Summary statistics based on the ratio of AERMOD predicted concentration to ISCST3 predicted concentrations for flat and simple terrain (see Appendix D).

	------ High 1st High ----------						----- High 2nd High ----		
	1hour	3hour	24hour	annual			1hour	3hour	24hour
average	1.04	1.09	1.14	1.33		average	1.03	1.10	1.22
high	4.25	2.82	3.15	3.89		high	3.15	2.67	3.41
low	0.32	0.26	0.24	0.30		low	0.28	0.26	0.22
Total No.	48	48	48	48		Total No.	48	48	48
no. of ratios > 2	5	5	7	10		no. of ratios > 2	4	6	6
no. of ratios > 3	2	0	1	6		no. of ratios > 3	2	0	1
no. of ratios > 4	1	0	0	0		no. of ratios > 4	0	0	0
no. of ratios < 0.5	8	6	7	4		no. of ratios < 0.5	8	6	5
no. of ratios <0.33	1	2	2	1		no of ratios <0.33	2	2	1
no. of ratios < 0.25	0	0	1	0		no of ratios < 0.25	0	0	1

The code for each scenario evaluated is as follows: The first 2 letters refer to the name of the hill: PH = Piedmont, MC = Montour Crosswind, MA = Montour Alongwind, CC = Cinder Cone Butte. The 3rd letter refers to the stack height: L = 30 meters, H = 150m. The fourth letter refers to the buoyancy: L = low, H = high. The fifth letter stands for the distance between the source and the hill: C = close or 1 kilometer, F = far or 10 km.

Also, the complex terrain analysis have been summarized in format similar to that found in the above table. Those summary statistics are found in Tables 5-2a and 5-2b . In this case, although the model is called “ISCST3", the complex terrain part of the model (COMPLEX1) is playing a significant role in producing the estimates on which the tables are based. [16]

Table 5-2a. Summary statistics based on the ratio of AERMOD predicted regulatory design concentration to ISCST3(COMPLEX1) predicted regulatory design concentrations for complex terrain (see Appendix E).

	----------High First High----------					-------High Second High-----		
	1 hour	3 hour	24 hour	annual		1 hour	3 hour	24 hour
AVERAGE	0.380	0.233	0.185	0.191		0.310	0.209	0.188
MAX	0.913	0.425	0.331	0.504		0.732	0.388	0.393
MIN	0.103	0.081	0.072	0.092		0.085	0.077	0.076
TOTAL NO	28	28	28	28		28	28	28
NO OF RATIOS>2	0	0	0	0		0	0	0
NO OF RATIOS>3	0	0	0	0		0	0	0
NO OF RATIOS>4	0	0	0	0		0	0	0
NO OF RATIOS<0.5	21	28	28	27		26	28	28
NO OF RATIOS<0.33	15	23	27	26		17	27	26
NO OF RATIOS<0.25	7	17	22	24		10	17	20

Table 5-2b. Summary statistics based on the ratio of AERMOD predicted regulatory design concentration to CTDMPLUS predicted regulatory design concentrations for complex terrain (see Appendix E).

	----------High First High----------					------High Second High-----		
	1 hour	3 hour	24 hour	annual		1 hour	3 hour	24 hour
AVERAGE	0.674	0.738	0.832	0.721		0.760	0.790	0.743
MAX	1.375	1.735	2.074	1.24		2.133	1.765	1.537
MIN	0.125	0.137	0.159	0.373		0.123	0.186	0.147
TOTAL NO	28	28	28	28		28	28	28
NO OF RATIOS>2	0	0	1	0		1	0	0
NO OF RATIOS>3	0	0	0	0		0	0	0
NO OF RATIOS>4	0	0	0	0		0	0	0

[16] In flat and simple terrain cases, the COMPLEX1 part of the ISCST3 model is not used.

Table 5-2b. Summary statistics based on the ratio of AERMOD predicted regulatory design concentration to CTDMPLUS predicted regulatory design concentrations for complex terrain (see Appendix E).								
NO OF RATIOS<0.5	12	8	6	6		10	11	9
NO OF RATIOS<0.33	5	6	4	0		6	5	3
NO OF RATIOS<0.25	2	3	2	0		2	2	1

5.2 Discussion of Flat and Simple Terrain Results.

As expected when a new model is developed, there were differences between the current and the proposed air dispersion model predictions. Table 5-1 shows that, on average (48 cases), the 2 flat terrain models produced similar concentration estimates over all the averaging times but with the differences growing larger as the with averaging time increased. However, Table 5-1 also indicates that for certain situations, the differences in the AERMOD predictions were higher or lower than ISCST3 predictions by up to a factor of 3 or more.

The results from the rural-shorter stacks-non-buoyant plume scenario (Figure 4-1), indicated that the AERMOD provided lower estimates (about ½) than ISCST3 for all averaging times until the stack height approached 20 meters. As the stack heights increased from 20 meters and higher in rural settings (Figure 4-2), AERMOD tended to provide smaller or similar short-term estimates and larger or much larger long-term estimates than ISCST3. Although the different meteorological data bases have some impact on the concentration ratios, the same pattern of results are seen.

The Model Evaluation Document (MED)[3], in which both AERMOD's and ISCST3's predictions where compared to ambient air quality data, generally supports these results. For one MED site with a low-level release in a flat rural setting, AERMOD short-term concentration predictions were about ½ of the ISCST3 estimates, with the AERMOD estimates more closely matching the observed values. The MED also included 3 rural, tall stack scenarios which showed results similar to those relationships seen in Figure 4-2. The AERMOD concentration estimates were similar to those generated by ISCST3 for short averaging times and were twice as high as ISCST3 for long term (annual) estimates. In all cases, the AERMOD concentration estimates were

closer to the those measured in the experiments. There were no small to medium-sized stacks, i.e., 10-35 meters tall, in the evaluation data bases.

For the urban case and shorter stacks (Figure 4-6), the above trend seen in the rural settings was reversed. For stacks between 5 and 10 meters, both the AERMOD short-term- and long-term-concentration estimates were higher than those generated by ISCST3; there was a tendency for the AERMOD/ISCST3 concentration ratios to be higher for the shorter averaging times and approaching unity for the annual averages. Again, the different meteorological data bases made some differences in the absolute values, but the pattern of the ratios remained the same. There were no short or medium-sized stacks located in urban settings in the MED against which to compare the short-stack urban results.

Several sources in simple terrain (receptor elevations below the top of the stack) were included in this study. For the rural setting, Figure 4-3 shows both medium and tall stack (greater that 100 meters) concentration estimates ratios. The 1)1 hour ratios for all 4 cases, and 2) the ratios for all the averaging times for the 200 meter stack case were about 1 (the two models produced the same concentration estimates). For the 35 meter stack cases, AERMOD tended to produce concentration estimates that are about 2 to 3 times higher than those from ISCST3 for the 3, 24 hour and annual averaging times. The MED suggests that[17], for tall stacks in simple or flat terrain, AERMOD will tend to produce similar concentration estimates to ISCST3 for the shorter averaging times and will tend to produce higher concentration estimates for the longer averaging times. The MED also shows that the AERMOD annual concentration estimates are generally closer to observed values than the ISCST3 predictions.

The urban simple terrain model comparisons provided results (Figure 4-8) that were quite different from the rural results for simple terrain. The AERMOD tall stack (200 m) urban estimates were consistently lower than those of ISCST3 (up to a factor of 4) while the 35 meter stack results were in general agreement for all averaging times. The one urban setting in the MED was found in a limited study for a tall stack. Because of the limited amount of data collected in

[17] The MED has a tall stack source in rolling terrain. For this source, AERMOD and ISCST3 estimates were similar for 3 and 24 hour averaging times; the AERMOD annual average estimate was about twice the ISCST3 estimate.

this particular study, only the short-term concentration estimates were evaluated and the AERMOD results were slightly less than those produced by ISCST3, with the AERMOD estimates more closely reflecting the measured values.

Figure 4-4 presents all 4 rural 35 meter stack cases in one chart. There is a pattern to all the comparisons: AERMOD and ISCST3 estimates are reasonably close for the short-term averaging time, and the AERMOD estimates grow larger (up to a factor of 3) than the ISCST3 estimates as the averaging time increases. The corresponding charts for urban settings (Figure 4-9) produced concentration estimates by both models that were in reasonable agreement over all averaging times for all 4 cases.

Several volume and area source configurations were also considered in this comparison. The rural and urban results, seen in Figures 4-5 and 4-10, indicate relatively close agreement for all averaging times, release heights, and source types. The exception to this general conclusion is the urban area surface source where the AERMOD concentration estimates were consistently higher than ISCST3 estimates and the difference being more dramatic (up to a factor of 3) for the shorter averaging times. The MED did not have any similar set of source configurations against which these results could be compared.

5.3 Discussion of Complex Terrain Results.

AERMOD consistently produced lower or significantly lower regulatory design concentrations estimates than those generated from the ISCST3(COMPLEX1) (Table 5-2a). This result was expected since COMPLEX1 is used for screening purposes and has been designed to be conservative[18]. The differences between the 2 models increased with averaging time. Also as expected for the AERMOD/CTDMPLUS comparison, the models agreed more closely, since the CTDMPLUS is a more refined, site-specific complex terrain model. Table 5-2b indicates that AERMOD also produced lower average regulatory design concentrations estimates when compared to those generated from CTDMPLUS. However, when examing the complex terrain

[18] That is, the model is designed to overestimate or produce concentration estimates which are larger than concentrations that one would measure.

charts (Figures 4-11 to 4-18), one sees a number of cases where AERMOD concentration estimates are higher than those from the CTDMPLUS (e.g. Figure 4-11, the Cinder Cone Butte case). Thus, AERMOD did not consistently underpredict CTDMPLUS's estimates, as was seen in the AERMOD/ISCST3(COMPLEX1) comparisons.

Such trends were also seen in the MED. The AERMOD concentration predictions were in closer agreement with the CTDMPLUS predictions than with the ISCST3(COMPLEX1) predictions. In both comparisons, the AERMOD predicted concentrations were lower than those from the other 2 models. In certain cases, the evaluation analysis showed large discrepancies (up to a factor of 8) between AERMOD and ISCST3 and discrepancies (up to a factor of 5) between AERMOD and CTDMPLUS. As mentioned before, in almost every case, the AERMOD concentration predictions were the closest to the air quality measurements, and, on average, showed a slight overprediction tendency.

6. COMPUTER RUN TIMES

As an additional feature to the consequence analysis, ISCST3 and AERMOD models were compiled and run on a typical personal computer**.** The purpose of this exercise was to provide the user community of a sense of the potential changes in the amount of time to run typical source configurations on their computer systems. The results are tabulated below in Table 6-1. The computer used to complete this table was a Pentium 200 megahertz computer with 32 megabytes of random access memory. Each source run evaluated 180 receptors in a polar grid (36 radials with 5 ring distances). One full year (8784 hours) of meteorological data was used for each run. Further details of the source configurations and setup are seen in Appendix F.

Table 6-1. Computer Run Times for Typical Source Configurations.

Source Type	AERMOD	ISCST3	AER/ISC RATIO
Point source	**2.07 minutes**	**0.32 minutes**	**6.5**
Volume source	**2.06**	**0.33**	**6.3**
Area source	**180**	**67.3**	**2. 68**

APPENDIX A

SIDE BY SIDE COMPARISON OF MODEL FEATURES: AERMOD VS ISCST3

Comparison of Dispersion Model Features: AERMOD vs. ISCST3			
Feature	**ISCST3**	**AERMOD**	**Comments**
Types of sources modeled	Point, area, and volume sources	Same as ISCST3	Models are comparable
Plume Rise	Uses Briggs equations with stack-top wind speed and vertical temperature gradient	In stable conditions, uses Briggs equations with winds and temperature gradient at stack top and half-way to final plume rise ; in convective conditions, plume rise I superposed on the displacements by random convective velocities	AERMOD is better because in stable conditions it factors in wind and temperature changes above stack top, and in unstable conditions it accounts for convective updrafts and downdrafts
Meteorological Data Input	One level of data accepted	An arbitrarily large number of data levels can be accommodated	AERMOD can adapt multiple levels of data to various stack and plume heights
Profiling Meteorological Data	Only wind speed is profiled	AERMOD creates profiles of wind, temperature, and turbulence, using all available measurement levels	AERMOD is much improved over ISCST3 in this area
Use of Meteorological Data in Plume Dispersion	Stack-top variables for all downwind distances	Variables measured throughout the plume depth (averaged from plume centerline to 2.15 sigma-z below centerline; changes with downwind distance)	AERMOD treatment is far more advanced than that of ISCST3; accounts for meteorological data throughout the plume depth
Plume Dispersion: General Treatment	Gaussian treatment in horizontal and vertical	Gaussian treatment in horizontal and in vertical for stable conditions; non-Gaussian probability density function in vertical for unstable conditions	AERMOD's unstable treatment of vertical dispersion is a more accurate portrayal of actual conditions
Urban Treatment	Urban option either on or off; no other specification available; all sources must be modeled either rural or urban	City population is specified; sources can individually be modeled rural or urban	AERMOD provides variable urban treatment as a function of city size, and can selectively model sources as rural or urban
Characterization of Modeling Domain Surface Characteristics	Choice of rural or urban	Selection by direction and month of roughness length, albedo, and Bowen ratio, providing much user flexibility	AERMOD provides the user with considerably more options in the selection of the surface characteristics

Comparison of Dispersion Model Features: AERMOD vs. ISCST3			
Feature	**ISCST3**	**AERMOD**	**Comments**
Boundary Layer Parameters	Wind speed, mixing height, and stability class	Friction velocity, Monin-Obukhov length, convective velocity scale, mechanical and convective mixing height, sensible heat flux	AERMOD provides parameters required for use with up-to-date planetary boundary layer (PBL) parameterizations; ISCST3 does not
Mixed Layer Height	Holzworth scheme; uses interpolation based upon maximum afternoon mixing height	Has convective and mechanical mixed layer height; convective height based upon hourly accumulation of sensible heat flux	AERMOD's formulation is significantly more advanced than that of ISCST3, includes a mechanical component, and in using hourly input data, provides a more realistic sequence of the diurnal mixing height changes
Terrain Depiction	Elevation at each receptor point	Controlling hill elevation and point elevation at each receptor, obtained from special terrain pre-processor (:AERMAP) that uses digital elevation model (DEM) data	AERMOD's terrain pre-processor provides information for advanced critical dividing streamline height algorithms and uses digital data to obtain receptor elevations
Plume Interaction in Terrain	Half-height correction in unstable conditions, level plume in stable conditions, 10-m "stand-off" distance from terrain surface	Determines critical dividing streamline height; computes a weighted average of two states: 1) plume climbs over the hill and 2) plume passes around the hill in a horizontal plane	AERMOD's use of critical dividing streamline height and non-level component in stable conditions provides more realistic predictions
Plume Dispersion: Plume Growth Rates	Based upon 6 discrete stability classes only; dispersion curves (Pasquill-Gifford) are based upon surface release experiments (Prairie Grass)	Uses profiles of vertical and horizontal turbulence (from measurements and/or PBL theory); variable with height; uses continuous growth functions rather than a discrete (stability-based) formulation	Use of turbulence-based plume growth with height dependence rather than that based upon stability class provides AERMOD with a substantial advancement over ISCST3 treatment

Comparison of Dispersion Model Features: AERMOD vs. ISCST3			
Feature	**ISCST3**	**AERMOD**	**Comments**
Plume Interaction with Mixing Lid: convective conditions	If plume centerline is above lid, a zero ground-level concentration is assumed	Three plume components are considered: a "direct" plume that is advected to the ground in a downdraft, an "indirect" plume caught in an updraft that reaches the lid and eventually is brought to the ground, and a plume that penetrates the mixing lid and disperses more slowly in the stable layer aloft (and which can re-enter the mixed layer and disperse to the ground)	AERMOD treatment avoids potential underpredictions suffered by ISCST3 due to its "all or nothing" treatment of the plume; AERMOD's use of convective updrafts and downdrafts in a probability density function approach is a significant advancement over ISCST3
Plume Interaction with Mixing Lid: stable conditions	The mixing lid is ignored (assumed to be infinitely high)	A mechanically mixed layer near the ground is considered. Plume reflection from an elevated lid is considered	AERMOD's use of a mechanically mixed layer is an advancement over the very simplistic ISCST3 approach

APPENDIX B

FIGURES FOR DESCRIBING COMPLEX TERRAIN

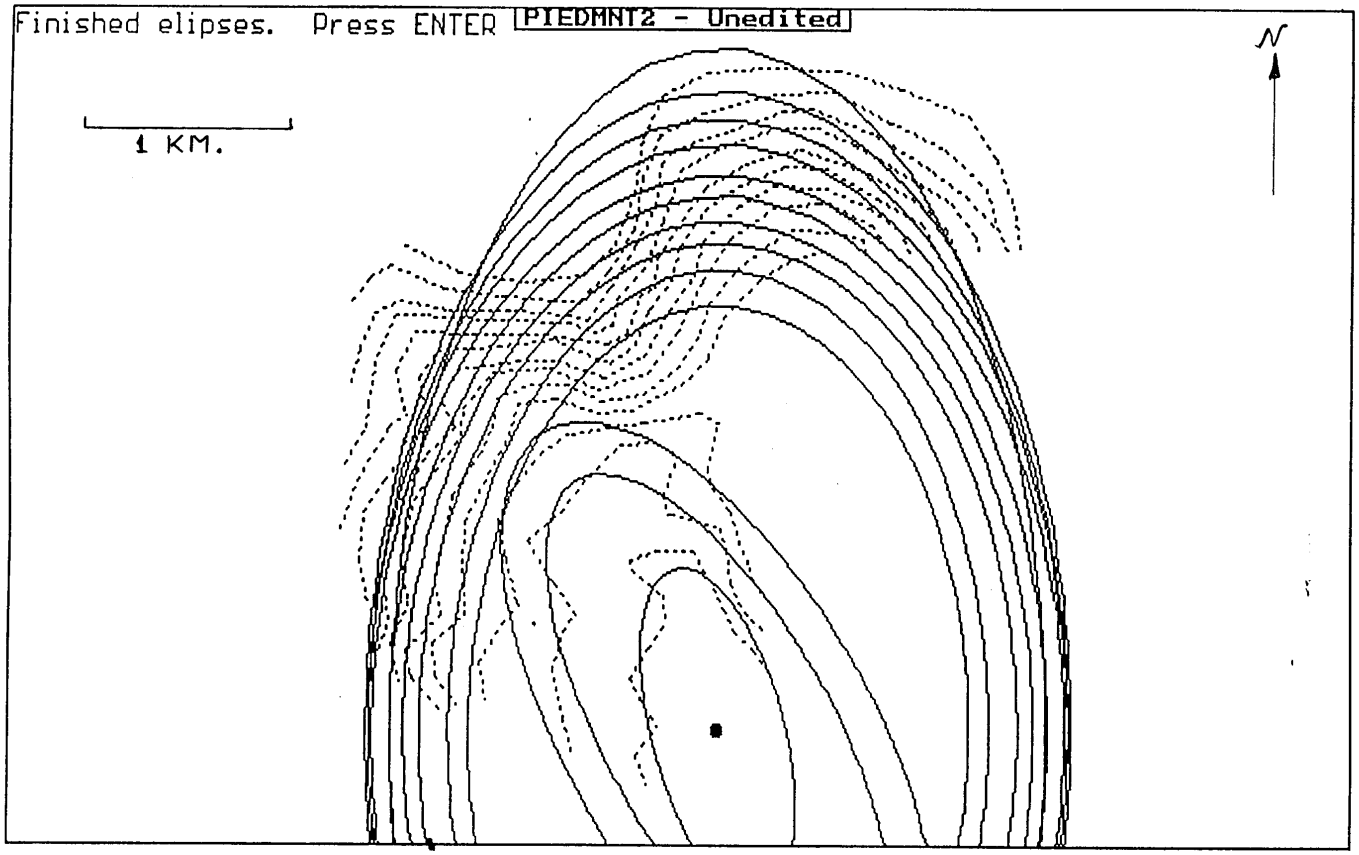


Figure B-1. Plot of Piedmont Hill Contours.*

* TERRAIN INFORMATION

HILL NAMED PIEDMONT HILL TOP: 2240.0 feet

Figure B-1 displays both actual and transformed contours for the Piedmont hill. The transformed contours were used in the modeling analysis. There are 2 sets of 13 contours; the dotted lines are the actual contours and the solid lines are the transformed or modeled contours. The elevations for the 13 contours are listed below:

1000.0 feet
1100.0
1200.0
1300.0
1400.0
1500.0
1600.0
1700.0
1800.0
1900.0
2000.0
2100.0

The actual receptor locations are listed in the AERMOD control files which are listed in Appendix C.

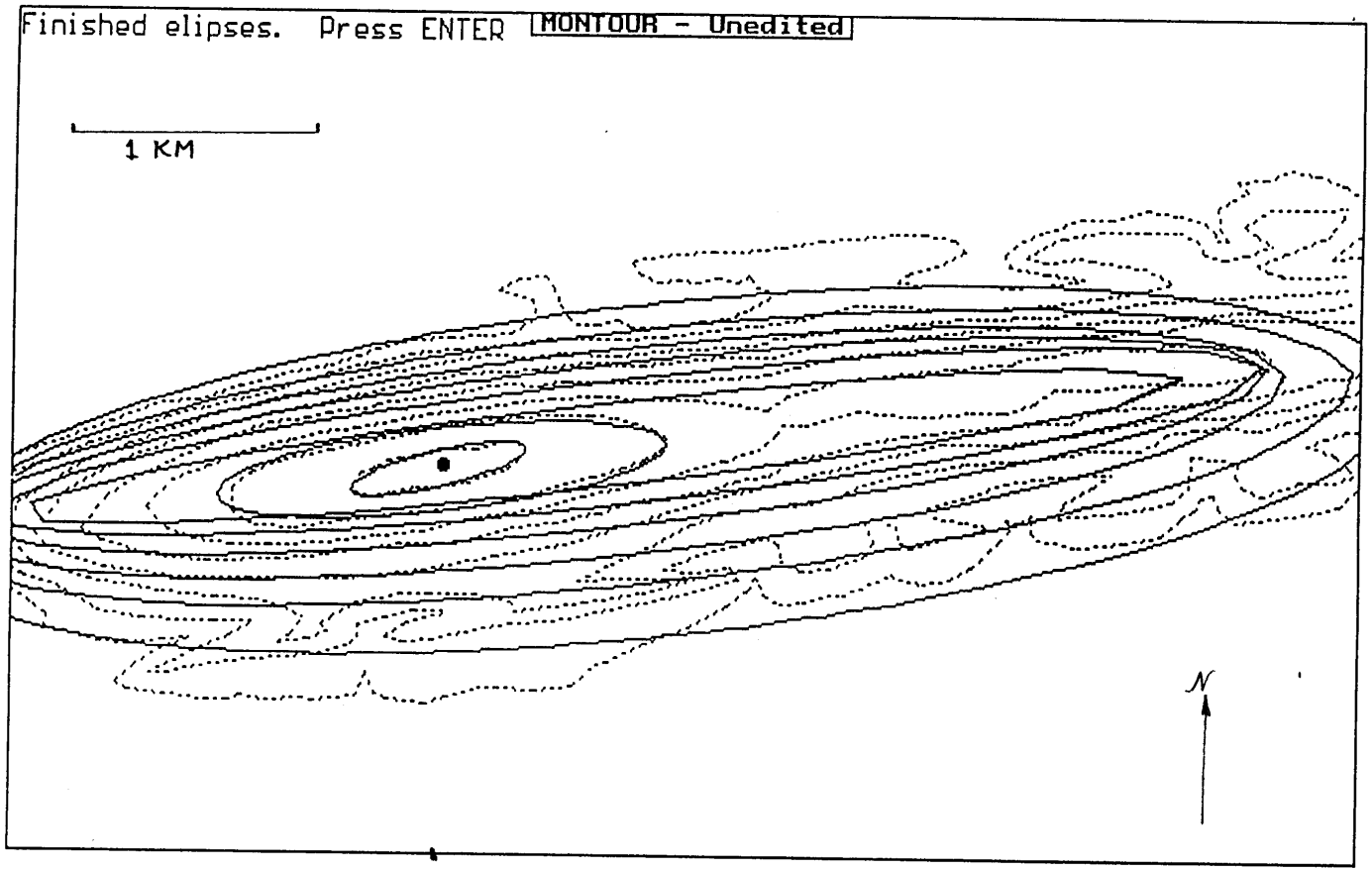


Figure B-2. Plot of Montour Ridge Contours.*

* TERRAIN INFORMATION

HILL NAMED MONTOUR HILL TOP: 1429.0 meters

Figure B-2 displays both actual and transformed contours for the Montour Ridge. The transformed contours were used in the modeling analysis. There are 2 sets of 8 contours; the dotted lines are the actual contours and the solid lines are the transformed or modeled contours. The elevations for the 8 contours are listed below:

700.0 meters
800.0
900.0
1000.0
1100.0
1200.0
1300.0
1400.0

The actual receptor locations are listed in the AERMOD control files which are listed in Appendix C.

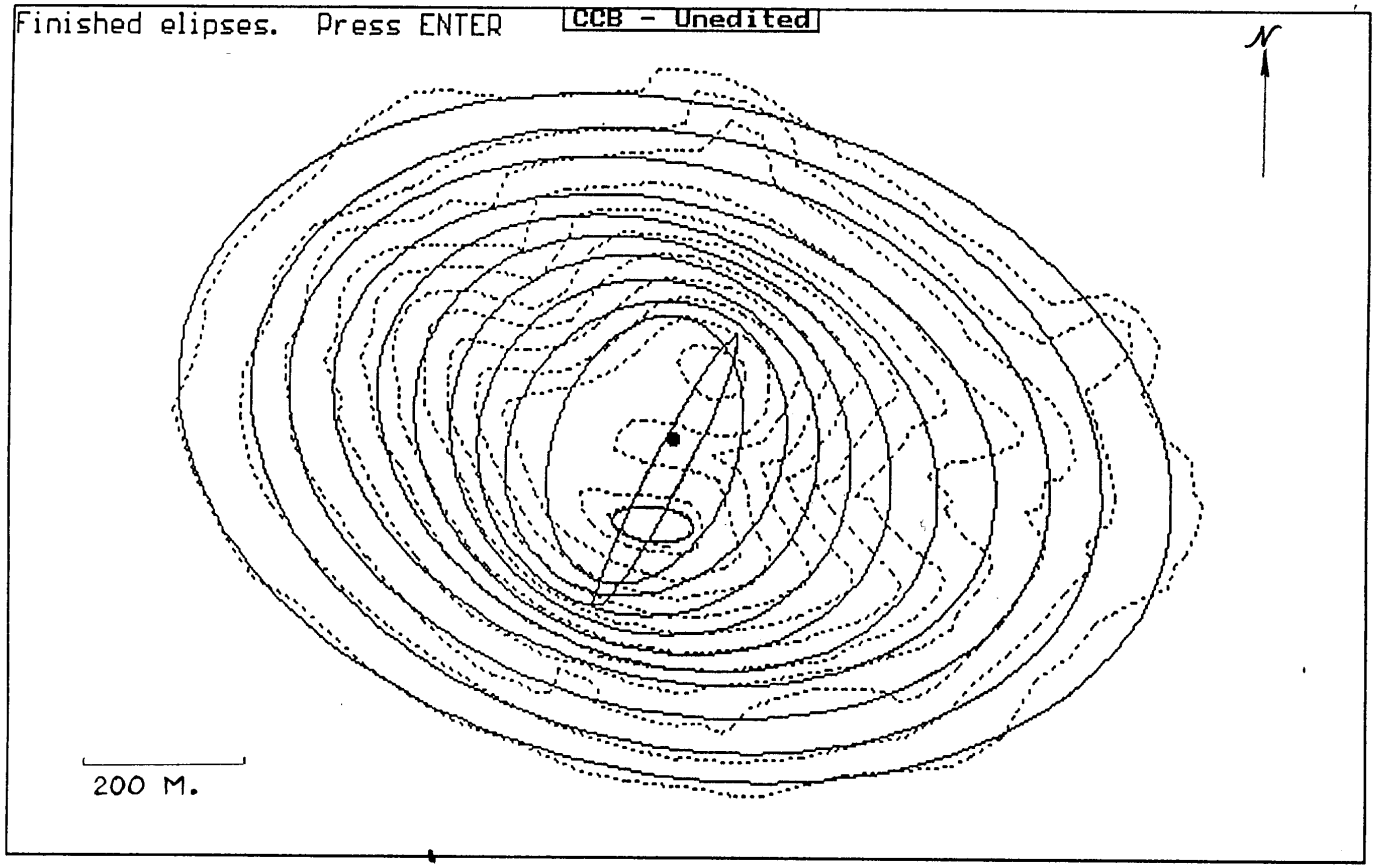


Figure 6-3. Plot of Cinder Cone Butte Contours.*

* TERRAIN INFORMATION

HILL NAMED CINDER CONE BUTTE (CCB) HILL TOP: 100.0 meters

Figure B-3 displays both actual and transformed contours for CCB. The transformed contours were used in the modeling analysis. There are 2 sets of 11 contours; the dotted lines are the actual contours and the solid lines are the transformed or modeled contours. The elevations for the 11 contours are listed below:

0.0 meters
5.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0

The actual receptor locations are listed in the AERMOD control files which are listed in Appendix C.

APPENDIX C

LOCATION OF SOURCE AND RECEPTORS FOR THE COMPLEX TERRAIN ANALYSIS

** Cinder Cone Butte
** Low Stack Height: 30 meters
** High Buoyancy Case: 6-m diameter, 30 m/s Exit Vel, 500 K
** *Close to Hill*: 1 km away
** Meteorology from 100-m Tower and Sodar

```
** Cinder Cone Butte
** Low Stack Height: 30 meters
** High Buoyancy Case: 6-m diameter, 30 m/s Exit Vel, 500 K
** Close to Hill: 1 km away
** Meteorology from 100-m Tower and Sodar
**
CO STARTING
   TITLEONE  Cinder Cone Butte: Source 1 km away
   TITLETWO  30-m Stack Height; High Buoyancy Case
   MODELOPT  CONC              MSGPRO
   AVERTIME  1 3 24 Period
   POLLUTID  SO2
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
   TERRHGTS  ELEV
CO FINISHED

SO STARTING
   ELEVUNIT  FEET
   LOCATION  STACK1  POINT  0.0  1500.0   3100.0
** Point Source       QS    HS    TS    VS   DS
** Parameters:       ----  ----  ----  ----  ---
   SRCPARAM  STACK1    1.   30.  500.  30.0  6.0

   SRCGROUP  ALL
SO FINISHED

RE STARTING
RE ELEVUNIT    FEET
**         X (meters) y(meters)  z (feet)
RE DISCCART      2.00   -302.00   3198.42    3395.27
RE DISCCART    -88.98   -269.90   3198.42    3395.27
RE DISCCART   -164.25   -208.74   3198.42    3395.27
RE DISCCART   -222.04   -130.75   3198.42    3395.27
RE DISCCART   -258.22    -40.01   3198.42    3395.27
RE DISCCART   -288.26     51.90   3198.42    3395.27
RE DISCCART   -287.25    147.62   3198.42    3395.27
RE DISCCART   -241.83    223.90   3198.42    3395.27
RE DISCCART   -146.77    217.43   3198.42    3395.27
RE DISCCART    -98.96    288.04   3198.42    3395.27
RE DISCCART    -11.03    302.58   3198.42    3395.27
RE DISCCART     78.05    263.18   3198.42    3395.27
RE DISCCART    154.00    201.72   3198.42    3395.27
RE DISCCART    211.91    123.27   3198.42    3395.27
RE DISCCART    256.99     38.11   3198.42    3395.27
RE DISCCART    196.67    -33.00   3198.42    3395.27
RE DISCCART    202.01   -107.64   3198.42    3395.27
RE DISCCART    253.73   -185.45   3198.42    3395.27
RE DISCCART    190.44   -256.50   3198.42    3395.27
RE DISCCART    103.16   -295.08   3198.42    3395.27
RE DISCCART      2.00   -278.00   3231.23    3395.27
RE DISCCART    -79.33   -250.67   3231.23    3395.27
RE DISCCART   -146.86   -196.29   3231.23    3395.27
RE DISCCART   -198.80   -127.07   3231.23    3395.27
RE DISCCART   -232.68    -47.04   3231.23    3395.27
RE DISCCART   -261.87     34.64   3231.23    3395.27
RE DISCCART   -267.17    121.16   3231.23    3395.27
RE DISCCART   -230.33    194.77   3231.23    3395.27
RE DISCCART   -146.35    179.65   3231.23    3395.27
```

** Cinder Cone Butte
** Low Stack Height: 30 meters
** High Buoyancy Case: 6-m diameter, 30 m/s Exit Vel, 500 K
** *Close to Hill*: 1 km away
** Meteorology from 100-m Tower and Sodar

RE DISCCART	-91.21	229.83	3231.23	3395.27
RE DISCCART	-26.62	275.52	3231.23	3395.27
RE DISCCART	55.30	248.31	3231.23	3395.27
RE DISCCART	126.01	197.64	3231.23	3395.27
RE DISCCART	179.34	129.32	3231.23	3395.27
RE DISCCART	202.47	52.18	3231.23	3395.27
RE DISCCART	162.42	-23.57	3231.23	3395.27
RE DISCCART	151.72	-91.57	3231.23	3395.27
RE DISCCART	201.61	-163.01	3231.23	3395.27
RE DISCCART	176.30	-232.57	3231.23	3395.27
RE DISCCART	97.36	-267.36	3231.23	3395.27
RE DISCCART	2.00	-251.00	3264.04	3395.27
RE DISCCART	-71.09	-230.09	3264.04	3395.27
RE DISCCART	-131.43	-182.39	3264.04	3395.27
RE DISCCART	-178.05	-120.85	3264.04	3395.27
RE DISCCART	-201.61	-47.29	3264.04	3395.27
RE DISCCART	-230.06	24.39	3264.04	3395.27
RE DISCCART	-237.00	100.64	3264.04	3395.27
RE DISCCART	-214.19	169.15	3264.04	3395.27
RE DISCCART	-140.21	150.71	3264.04	3395.27
RE DISCCART	-81.40	187.62	3264.04	3395.27
RE DISCCART	-31.28	243.37	3264.04	3395.27
RE DISCCART	41.60	231.33	3264.04	3395.27
RE DISCCART	105.42	187.96	3264.04	3395.27
RE DISCCART	155.35	129.97	3264.04	3395.27
RE DISCCART	163.34	61.63	3264.04	3395.27
RE DISCCART	135.40	-9.50	3264.04	3395.27
RE DISCCART	113.60	-71.80	3264.04	3395.27
RE DISCCART	149.22	-140.06	3264.04	3395.27
RE DISCCART	151.97	-204.88	3264.04	3395.27
RE DISCCART	84.02	-240.37	3264.04	3395.27
RE DISCCART	2.00	-231.00	3296.85	3395.27
RE DISCCART	-61.01	-208.49	3296.85	3395.27
RE DISCCART	-114.04	-168.94	3296.85	3395.27
RE DISCCART	-153.87	-115.63	3296.85	3395.27
RE DISCCART	-180.97	-54.34	3296.85	3395.27
RE DISCCART	-206.06	7.87	3296.85	3395.27
RE DISCCART	-215.00	73.91	3296.85	3395.27
RE DISCCART	-195.31	130.00	3296.85	3395.27
RE DISCCART	-129.76	120.63	3296.85	3395.27
RE DISCCART	-74.20	152.79	3296.85	3395.27
RE DISCCART	-32.19	204.87	3296.85	3395.27
RE DISCCART	31.93	209.23	3296.85	3395.27
RE DISCCART	86.72	172.28	3296.85	3395.27
RE DISCCART	130.34	123.48	3296.85	3395.27
RE DISCCART	136.25	61.17	3296.85	3395.27
RE DISCCART	114.98	-2.29	3296.85	3395.27
RE DISCCART	85.47	-49.87	3296.85	3395.27
RE DISCCART	106.04	-113.29	3296.85	3395.27
RE DISCCART	125.03	-175.86	3296.85	3395.27
RE DISCCART	73.77	-215.85	3296.85	3395.27
RE DISCCART	3.00	-206.00	3329.66	3395.27
RE DISCCART	-53.07	-188.80	3329.66	3395.27
RE DISCCART	-99.24	-153.39	3329.66	3395.27
RE DISCCART	-134.94	-107.29	3329.66	3395.27
RE DISCCART	-159.94	-54.13	3329.66	3395.27
RE DISCCART	-179.33	1.32	3329.66	3395.27
RE DISCCART	-187.72	58.87	3329.66	3395.27
RE DISCCART	-156.80	93.46	3329.66	3395.27

```
                    ** Cinder Cone Butte
                ** Low Stack Height: 30 meters
        ** High Buoyancy Case: 6-m diameter, 30 m/s Exit Vel, 500 K
                    ** Close to Hill: 1 km away
              ** Meteorology from 100-m Tower and Sodar

RE DISCCART    -99.24     95.55   3329.66    3395.27
RE DISCCART    -55.52    134.37   3329.66    3395.27
RE DISCCART    -17.95    179.52   3329.66    3395.27
RE DISCCART     36.11    181.51   3329.66    3395.27
RE DISCCART     83.25    147.75   3329.66    3395.27
RE DISCCART    114.87     99.51   3329.66    3395.27
RE DISCCART    104.12     42.87   3329.66    3395.27
RE DISCCART     72.48     -4.28   3329.66    3395.27
RE DISCCART     50.78    -31.31   3329.66    3395.27
RE DISCCART     69.73    -83.64   3329.66    3395.27
RE DISCCART     88.06   -138.92   3329.66    3395.27
RE DISCCART     65.18   -187.19   3329.66    3395.27
RE DISCCART      2.00   -181.00   3362.46    3395.27
RE DISCCART    -51.36   -161.23   3362.46    3395.27
RE DISCCART    -94.97   -124.59   3362.46    3395.27
RE DISCCART   -127.05    -78.21   3362.46    3395.27
RE DISCCART   -143.69    -23.72   3362.46    3395.27
RE DISCCART   -161.36     30.37   3362.46    3395.27
RE DISCCART   -125.43     62.70   3362.46    3395.27
RE DISCCART    -72.68     83.20   3362.46    3395.27
RE DISCCART    -32.04    122.40   3362.46    3395.27
RE DISCCART      7.68    162.36   3362.46    3395.27
RE DISCCART     59.05    141.43   3362.46    3395.27
RE DISCCART     87.00     94.58   3362.46    3395.27
RE DISCCART     83.26     38.04   3362.46    3395.27
RE DISCCART     41.54      8.84   3362.46    3395.27
RE DISCCART    -12.50     25.13   3362.46    3395.27
RE DISCCART    -54.22      2.65   3362.46    3395.27
RE DISCCART    -17.83    -30.31   3362.46    3395.27
RE DISCCART     36.25    -48.00   3362.46    3395.27
RE DISCCART     52.65   -100.60   3362.46    3395.27
RE DISCCART     57.52   -155.07   3362.46    3395.27
RE DISCCART      4.00   -146.00   3395.27    3395.27
RE DISCCART    -22.33   -143.15   3395.27    3395.27
RE DISCCART    -46.82   -133.11   3395.27    3395.27
RE DISCCART    -67.86   -117.36   3395.27    3395.27
RE DISCCART    -82.70    -95.60   3395.27    3395.27
RE DISCCART    -88.59    -70.00   3395.27    3395.27
RE DISCCART    -66.55    -64.01   3395.27    3395.27
RE DISCCART    -40.90    -69.61   3395.27    3395.27
RE DISCCART    -14.47    -72.14   3395.27    3395.27
RE DISCCART     10.97    -79.29   3395.27    3395.27
RE DISCCART     23.83   -101.15   3395.27    3395.27
RE DISCCART     23.86   -127.28   3395.27    3395.27
RE DISCCART      7.13   -144.96   3395.27    3395.27
RE DISCCART     15.65     73.30   3395.27    3395.27
RE DISCCART      3.80     96.84   3395.27    3395.27
RE DISCCART      9.99    119.90   3395.27    3395.27
RE DISCCART     34.87    124.11   3395.27    3395.27
RE DISCCART     55.86    108.49   3395.27    3395.27
RE DISCCART     65.52     85.47   3395.27    3395.27
RE DISCCART     57.11     61.70   3395.27    3395.27

RE FINISHED

ME STARTING
   SURFFILE  SURFACE  FREE
   PROFFILE  PROFILE  FREE
   SURFDATA  99999  1994  Tower/Sodar
```

```
                    ** Cinder Cone Butte
                 ** Low Stack Height: 30 meters
        ** High Buoyancy Case: 6-m diameter, 30 m/s Exit Vel, 500 K
                 ** Close to Hill: 1 km away
              ** Meteorology from 100-m Tower and Sodar

   UAIRDATA  99999  1994  Tower/Sodar
   SITEDATA  00000  1994  Tower/Sodar
ME FINISHED

OU STARTING
   RECTABLE  ALLAVE  FIRST-SECOND
OU FINISHED
```

** Cinder Cone Butte
** Low Stack Height: 30 meters
** High Buoyancy Case: 6-m diameter, 30 m/s Exit Vel, 500 K
** *Far from Hill*: 10 km away
** Meteorology from 100-m Tower and Sodar

```
** Cinder Cone Butte
** Low Stack Height: 30 meters
** High Buoyancy Case: 6-m diameter, 30 m/s Exit Vel, 500 K
** Far from Hill: 10 km away
** Meteorology from 100-m Tower and Sodar
**
CO STARTING
   TITLEONE  Cinder Cone Butte: Source 10 km away
   TITLETWO  30-m Stack Height; High Buoyancy Case
   MODELOPT  CONC              MSGPRO
   AVERTIME  1 3 24 Period
   POLLUTID  SO2
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
   TERRHGTS  ELEV
CO FINISHED

SO STARTING
   ELEVUNIT  FEET
   LOCATION  STACK1  POINT  0.0   10500.0   3100.0
** Point Source       QS    HS    TS    VS   DS
** Parameters:       ----  ----  ----  ----  ---
   SRCPARAM  STACK1    1.   30.  500.  30.0  6.0

   SRCGROUP  ALL
SO FINISHED

RE STARTING
RE ELEVUNIT    FEET
**         X (meters) y(meters)  z (feet)
RE DISCCART      2.00   -302.00   3198.42    3395.27
RE DISCCART    -88.98   -269.90   3198.42    3395.27
RE DISCCART   -164.25   -208.74   3198.42    3395.27
RE DISCCART   -222.04   -130.75   3198.42    3395.27
RE DISCCART   -258.22    -40.01   3198.42    3395.27
RE DISCCART   -288.26     51.90   3198.42    3395.27
RE DISCCART   -287.25    147.62   3198.42    3395.27
RE DISCCART   -241.83    223.90   3198.42    3395.27
RE DISCCART   -146.77    217.43   3198.42    3395.27
RE DISCCART    -98.96    288.04   3198.42    3395.27
RE DISCCART    -11.03    302.58   3198.42    3395.27
RE DISCCART     78.05    263.18   3198.42    3395.27
RE DISCCART    154.00    201.72   3198.42    3395.27
RE DISCCART    211.91    123.27   3198.42    3395.27
RE DISCCART    256.99     38.11   3198.42    3395.27
RE DISCCART    196.67    -33.00   3198.42    3395.27
RE DISCCART    202.01   -107.64   3198.42    3395.27
RE DISCCART    253.73   -185.45   3198.42    3395.27
RE DISCCART    190.44   -256.50   3198.42    3395.27
RE DISCCART    103.16   -295.08   3198.42    3395.27
RE DISCCART      2.00   -278.00   3231.23    3395.27
RE DISCCART    -79.33   -250.67   3231.23    3395.27
RE DISCCART   -146.86   -196.29   3231.23    3395.27
RE DISCCART   -198.80   -127.07   3231.23    3395.27
RE DISCCART   -232.68    -47.04   3231.23    3395.27
RE DISCCART   -261.87     34.64   3231.23    3395.27
RE DISCCART   -267.17    121.16   3231.23    3395.27
RE DISCCART   -230.33    194.77   3231.23    3395.27
RE DISCCART   -146.35    179.65   3231.23    3395.27
```

** Cinder Cone Butte
** Low Stack Height: 30 meters
** High Buoyancy Case: 6-m diameter, 30 m/s Exit Vel, 500 K
** *Far from Hill*: 10 km away
** Meteorology from 100-m Tower and Sodar

RE DISCCART	-91.21	229.83	3231.23	3395.27
RE DISCCART	-26.62	275.52	3231.23	3395.27
RE DISCCART	55.30	248.31	3231.23	3395.27
RE DISCCART	126.01	197.64	3231.23	3395.27
RE DISCCART	179.34	129.32	3231.23	3395.27
RE DISCCART	202.47	52.18	3231.23	3395.27
RE DISCCART	162.42	-23.57	3231.23	3395.27
RE DISCCART	151.72	-91.57	3231.23	3395.27
RE DISCCART	201.61	-163.01	3231.23	3395.27
RE DISCCART	176.30	-232.57	3231.23	3395.27
RE DISCCART	97.36	-267.36	3231.23	3395.27
RE DISCCART	2.00	-251.00	3264.04	3395.27
RE DISCCART	-71.09	-230.09	3264.04	3395.27
RE DISCCART	-131.43	-182.39	3264.04	3395.27
RE DISCCART	-178.05	-120.85	3264.04	3395.27
RE DISCCART	-201.61	-47.29	3264.04	3395.27
RE DISCCART	-230.06	24.39	3264.04	3395.27
RE DISCCART	-237.00	100.64	3264.04	3395.27
RE DISCCART	-214.19	169.15	3264.04	3395.27
RE DISCCART	-140.21	150.71	3264.04	3395.27
RE DISCCART	-81.40	187.62	3264.04	3395.27
RE DISCCART	-31.28	243.37	3264.04	3395.27
RE DISCCART	41.60	231.33	3264.04	3395.27
RE DISCCART	105.42	187.96	3264.04	3395.27
RE DISCCART	155.35	129.97	3264.04	3395.27
RE DISCCART	163.34	61.63	3264.04	3395.27
RE DISCCART	135.40	-9.50	3264.04	3395.27
RE DISCCART	113.60	-71.80	3264.04	3395.27
RE DISCCART	149.22	-140.06	3264.04	3395.27
RE DISCCART	151.97	-204.88	3264.04	3395.27
RE DISCCART	84.02	-240.37	3264.04	3395.27
RE DISCCART	2.00	-231.00	3296.85	3395.27
RE DISCCART	-61.01	-208.49	3296.85	3395.27
RE DISCCART	-114.04	-168.94	3296.85	3395.27
RE DISCCART	-153.87	-115.63	3296.85	3395.27
RE DISCCART	-180.97	-54.34	3296.85	3395.27
RE DISCCART	-206.06	7.87	3296.85	3395.27
RE DISCCART	-215.00	73.91	3296.85	3395.27
RE DISCCART	-195.31	130.00	3296.85	3395.27
RE DISCCART	-129.76	120.63	3296.85	3395.27
RE DISCCART	-74.20	152.79	3296.85	3395.27
RE DISCCART	-32.19	204.87	3296.85	3395.27
RE DISCCART	31.93	209.23	3296.85	3395.27
RE DISCCART	86.72	172.28	3296.85	3395.27
RE DISCCART	130.34	123.48	3296.85	3395.27
RE DISCCART	136.25	61.17	3296.85	3395.27
RE DISCCART	114.98	-2.29	3296.85	3395.27
RE DISCCART	85.47	-49.87	3296.85	3395.27
RE DISCCART	106.04	-113.29	3296.85	3395.27
RE DISCCART	125.03	-175.86	3296.85	3395.27
RE DISCCART	73.77	-215.85	3296.85	3395.27
RE DISCCART	3.00	-206.00	3329.66	3395.27
RE DISCCART	-53.07	-188.80	3329.66	3395.27
RE DISCCART	-99.24	-153.39	3329.66	3395.27
RE DISCCART	-134.94	-107.29	3329.66	3395.27
RE DISCCART	-159.94	-54.13	3329.66	3395.27
RE DISCCART	-179.33	1.32	3329.66	3395.27
RE DISCCART	-187.72	58.87	3329.66	3395.27
RE DISCCART	-156.80	93.46	3329.66	3395.27

** Cinder Cone Butte
** Low Stack Height: 30 meters
** High Buoyancy Case: 6-m diameter, 30 m/s Exit Vel, 500 K
** *Far from Hill*: 10 km away
** Meteorology from 100-m Tower and Sodar

```
RE DISCCART    -99.24     95.55   3329.66    3395.27
RE DISCCART    -55.52    134.37   3329.66    3395.27
RE DISCCART    -17.95    179.52   3329.66    3395.27
RE DISCCART     36.11    181.51   3329.66    3395.27
RE DISCCART     83.25    147.75   3329.66    3395.27
RE DISCCART    114.87     99.51   3329.66    3395.27
RE DISCCART    104.12     42.87   3329.66    3395.27
RE DISCCART     72.48     -4.28   3329.66    3395.27
RE DISCCART     50.78    -31.31   3329.66    3395.27
RE DISCCART     69.73    -83.64   3329.66    3395.27
RE DISCCART     88.06   -138.92   3329.66    3395.27
RE DISCCART     65.18   -187.19   3329.66    3395.27
RE DISCCART      2.00   -181.00   3362.46    3395.27
RE DISCCART    -51.36   -161.23   3362.46    3395.27
RE DISCCART    -94.97   -124.59   3362.46    3395.27
RE DISCCART   -127.05    -78.21   3362.46    3395.27
RE DISCCART   -143.69    -23.72   3362.46    3395.27
RE DISCCART   -161.36     30.37   3362.46    3395.27
RE DISCCART   -125.43     62.70   3362.46    3395.27
RE DISCCART    -72.68     83.20   3362.46    3395.27
RE DISCCART    -32.04    122.40   3362.46    3395.27
RE DISCCART      7.68    162.36   3362.46    3395.27
RE DISCCART     59.05    141.43   3362.46    3395.27
RE DISCCART     87.00     94.58   3362.46    3395.27
RE DISCCART     83.26     38.04   3362.46    3395.27
RE DISCCART     41.54      8.84   3362.46    3395.27
RE DISCCART    -12.50     25.13   3362.46    3395.27
RE DISCCART    -54.22      2.65   3362.46    3395.27
RE DISCCART    -17.83    -30.31   3362.46    3395.27
RE DISCCART     36.25    -48.00   3362.46    3395.27
RE DISCCART     52.65   -100.60   3362.46    3395.27
RE DISCCART     57.52   -155.07   3362.46    3395.27
RE DISCCART      4.00   -146.00   3395.27    3395.27
RE DISCCART    -22.33   -143.15   3395.27    3395.27
RE DISCCART    -46.82   -133.11   3395.27    3395.27
RE DISCCART    -67.86   -117.36   3395.27    3395.27
RE DISCCART    -82.70    -95.60   3395.27    3395.27
RE DISCCART    -88.59    -70.00   3395.27    3395.27
RE DISCCART    -66.55    -64.01   3395.27    3395.27
RE DISCCART    -40.90    -69.61   3395.27    3395.27
RE DISCCART    -14.47    -72.14   3395.27    3395.27
RE DISCCART     10.97    -79.29   3395.27    3395.27
RE DISCCART     23.83   -101.15   3395.27    3395.27
RE DISCCART     23.86   -127.28   3395.27    3395.27
RE DISCCART      7.13   -144.96   3395.27    3395.27
RE DISCCART     15.65     73.30   3395.27    3395.27
RE DISCCART      3.80     96.84   3395.27    3395.27
RE DISCCART      9.99    119.90   3395.27    3395.27
RE DISCCART     34.87    124.11   3395.27    3395.27
RE DISCCART     55.86    108.49   3395.27    3395.27
RE DISCCART     65.52     85.47   3395.27    3395.27
RE DISCCART     57.11     61.70   3395.27    3395.27

RE FINISHED

ME STARTING
   SURFFILE  SURFACE  FREE
   PROFFILE  PROFILE  FREE
   SURFDATA  99999  1994  Tower/Sodar
```

```
                    ** Cinder Cone Butte
                 ** Low Stack Height: 30 meters
        ** High Buoyancy Case: 6-m diameter, 30 m/s Exit Vel, 500 K
                 ** Far from Hill: 10 km away
              ** Meteorology from 100-m Tower and Sodar

   UAIRDATA  99999  1994  Tower/Sodar
   SITEDATA  00000  1994  Tower/Sodar
ME FINISHED

OU STARTING
   RECTABLE  ALLAVE  FIRST-SECOND
OU FINISHED
```

```
                    ** Montour Alongwind Hill
                ** High Stack Height: 150 meters
        ** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
                ** Close to Hill: 1 km away
            ** Meteorology from 100-m Tower and Sodar

** Montour Alongwind Hill
** High Stack Height: 150 meters
** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
** Close to Hill: 1 km away
** Meteorology from 100-m Tower and Sodar
**
CO STARTING
   TITLEONE  Montour Alongwind Hill: Source 1 km away
   TITLETWO  150-m Stack Height; Low Buoyancy Case
   MODELOPT  CONC             MSGPRO
   AVERTIME  1 3 24 Period
   POLLUTID  SO2
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
**   TERRHGTS  ELEV
CO FINISHED

SO STARTING
   ELEVUNIT  FEET
   LOCATION  STACK1  POINT  -3500.0   0.0   700.0
** Point Source       QS    HS    TS    VS   DS
** Parameters:       ----  ----  ----  ----  ---
   SRCPARAM  STACK1    1.  150.  400.  10.0  2.0

   SRCGROUP  ALL
SO FINISHED

RE STARTING
RE ELEVUNIT    FEET
**RE DISCCART    5151.00    390.00    800.00    1400.
**RE DISCCART    4531.46    -60.49    800.00    1400.
**RE DISCCART    3756.52   -233.28    800.00    1400.
**RE DISCCART    3193.14    -42.10    800.00    1400.
**RE DISCCART    2708.92   -488.69    800.00    1400.
**RE DISCCART    1899.55   -738.38    800.00    1400.
**RE DISCCART    1495.27   -736.13    800.00    1400.
**RE DISCCART     451.18  -1149.47    800.00    1400.
**RE DISCCART     -87.14  -1069.58    800.00    1400.
**RE DISCCART   -1184.02  -1467.76    800.00    1400.
**RE DISCCART   -1206.48  -1152.95    800.00    1400.
**RE DISCCART   -2342.48   -720.47    800.00    1400.
**RE DISCCART   -1815.80    157.59    800.00    1400.
**RE DISCCART    -655.12    645.66    800.00    1400.
**RE DISCCART     566.85    934.26    800.00    1400.
**RE DISCCART    1815.48   1083.97    800.00    1400.
**RE DISCCART    3055.76   1208.49    800.00    1400.
**RE DISCCART    3391.81   1562.14    800.00    1400.
**RE DISCCART    3901.96   1746.68    800.00    1400.
**RE DISCCART    4661.76   1962.20    800.00    1400.
**RE DISCCART    5166.00    608.00    900.00    1400.
**RE DISCCART    4336.52    340.43    900.00    1400.
**RE DISCCART    3522.66    157.12    900.00    1400.
**RE DISCCART    2660.46     32.61    900.00    1400.
**RE DISCCART    1842.27   -256.35    900.00    1400.
**RE DISCCART    1059.77   -603.44    900.00    1400.
**RE DISCCART    1171.93   -809.29    900.00    1400.
**RE DISCCART     680.73  -1007.03    900.00    1400.
**RE DISCCART    -127.60   -939.83    900.00    1400.
**RE DISCCART    -820.39  -1311.66    900.00    1400.
```

** Montour Alongwind Hill
** High Stack Height: 150 meters
** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
** Close to Hill: 1 km away
** Meteorology from 100-m Tower and Sodar

```
**RE DISCCART   -1293.17   -962.38    900.00    1400.
**RE DISCCART   -2135.70   -746.90    900.00    1400.
**RE DISCCART   -1987.28    -70.91    900.00    1400.
**RE DISCCART   -1219.15    337.75    900.00    1400.
**RE DISCCART    -402.59    646.87    900.00    1400.
**RE DISCCART     448.93    798.78    900.00    1400.
**RE DISCCART    1315.11    876.65    900.00    1400.
**RE DISCCART    2165.93   1048.41    900.00    1400.
**RE DISCCART    3028.58   1139.92    900.00    1400.
**RE DISCCART    3884.88   1274.68    900.00    1400.
**RE DISCCART    5098.00    693.00   1000.00    1400.
**RE DISCCART    4384.83    469.68   1000.00    1400.
**RE DISCCART    3648.04    363.24   1000.00    1400.
**RE DISCCART    2921.62    191.68   1000.00    1400.
**RE DISCCART    2197.11     45.32   1000.00    1400.
**RE DISCCART    1492.91   -205.21   1000.00    1400.
**RE DISCCART     805.11   -496.92   1000.00    1400.
**RE DISCCART      89.87   -703.05   1000.00    1400.
**RE DISCCART    -642.06   -839.00   1000.00    1400.
**RE DISCCART   -1389.53   -833.49   1000.00    1400.
**RE DISCCART   -2087.11   -609.10   1000.00    1400.
**RE DISCCART   -1759.10    -27.47   1000.00    1400.
**RE DISCCART   -1089.79    298.80   1000.00    1400.
**RE DISCCART    -380.89    535.48   1000.00    1400.
**RE DISCCART     344.93    701.43   1000.00    1400.
**RE DISCCART    1085.83    759.47   1000.00    1400.
**RE DISCCART    1824.18    855.77   1000.00    1400.
**RE DISCCART    2555.99   1001.84   1000.00    1400.
**RE DISCCART    3291.01   1072.32   1000.00    1400.
**RE DISCCART    4023.03   1161.59   1000.00    1400.
**RE DISCCART    4952.00    785.00   1100.00    1400.
**RE DISCCART    4289.30    566.42   1100.00    1400.
**RE DISCCART    3583.69    469.90   1100.00    1400.
**RE DISCCART    2904.20    315.43   1100.00    1400.
**RE DISCCART    2205.43    178.62   1100.00    1400.
**RE DISCCART    1553.80    -82.14   1100.00    1400.
**RE DISCCART     881.25   -311.24   1100.00    1400.
**RE DISCCART     198.55   -506.91   1100.00    1400.
**RE DISCCART    -493.47   -638.49   1100.00    1400.
**RE DISCCART   -1201.37   -713.78   1100.00    1400.
**RE DISCCART   -1869.93   -507.27   1100.00    1400.
**RE DISCCART   -1464.60      -.34   1100.00    1400.
**RE DISCCART    -827.13    314.43   1100.00    1400.
**RE DISCCART    -135.85    488.72   1100.00    1400.
**RE DISCCART     563.35    607.51   1100.00    1400.
**RE DISCCART    1273.30    645.20   1100.00    1400.
**RE DISCCART    1965.33    791.11   1100.00    1400.
**RE DISCCART    2666.34    910.29   1100.00    1400.
**RE DISCCART    3370.16   1003.41   1100.00    1400.
**RE DISCCART    4070.69   1120.04   1100.00    1400.
RE DISCCART    1655.00    146.00   1200.00    1400.
RE DISCCART    1075.54    -98.85   1200.00    1400.
RE DISCCART     481.15   -308.48   1200.00    1400.
RE DISCCART    -125.99   -475.98   1200.00    1400.
RE DISCCART    -747.97   -576.12   1200.00    1400.
RE DISCCART   -1367.68   -518.96   1200.00    1400.
RE DISCCART   -1332.89    -67.94   1200.00    1400.
RE DISCCART    -761.22    195.56   1200.00    1400.
RE DISCCART    -149.69    347.21   1200.00    1400.
```

```
                    ** Montour Alongwind Hill
                 ** High Stack Height: 150 meters
        ** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
                    ** Close to Hill: 1 km away
              ** Meteorology from 100-m Tower and Sodar

RE DISCCART     465.45    485.10   1200.00    1400.
RE DISCCART    1093.57    506.82   1200.00    1400.
RE DISCCART    1712.61    443.97   1200.00    1400.
RE DISCCART    2281.57    691.14   1200.00    1400.
RE DISCCART    2905.52    783.48   1200.00    1400.
RE DISCCART    3514.58    925.91   1200.00    1400.
RE DISCCART    4142.81    947.59   1200.00    1400.
RE DISCCART    4040.15    665.33   1200.00    1400.
RE DISCCART    3413.23    607.18   1200.00    1400.
RE DISCCART    2851.31    427.99   1200.00    1400.
RE DISCCART    2224.11    416.49   1200.00    1400.
RE DISCCART     141.00   -299.00   1300.00    1400.
RE DISCCART    -108.32   -341.14   1300.00    1400.
RE DISCCART    -358.91   -376.51   1300.00    1400.
RE DISCCART    -607.97   -421.69   1300.00    1400.
RE DISCCART    -857.60   -453.09   1300.00    1400.
RE DISCCART   -1083.05   -366.88   1300.00    1400.
RE DISCCART   -1074.53   -137.83   1300.00    1400.
RE DISCCART    -875.96     10.86   1300.00    1400.
RE DISCCART    -637.92     95.96   1300.00    1400.
RE DISCCART    -395.29    168.10   1300.00    1400.
RE DISCCART    -152.75    240.59   1300.00    1400.
RE DISCCART      92.72    301.83   1300.00    1400.
RE DISCCART     342.50    342.65   1300.00    1400.
RE DISCCART     592.42    378.00   1300.00    1400.
RE DISCCART     843.23    366.02   1300.00    1400.
RE DISCCART    1081.96    287.07   1300.00    1400.
RE DISCCART    1102.55     95.11   1300.00    1400.
RE DISCCART     886.71    -29.07   1300.00    1400.
RE DISCCART     649.92   -118.37   1300.00    1400.
RE DISCCART     420.08   -223.10   1300.00    1400.
RE DISCCART    -373.00    -31.00   1400.00    1400.
RE DISCCART    -287.24     27.50   1400.00    1400.
RE DISCCART    -188.10     58.73   1400.00    1400.
RE DISCCART     -89.24     90.31   1400.00    1400.
RE DISCCART       9.09    119.15   1400.00    1400.
RE DISCCART     113.04    125.22   1400.00    1400.
RE DISCCART     214.03    144.82   1400.00    1400.
RE DISCCART     311.84    177.82   1400.00    1400.
RE DISCCART     410.80    157.11   1400.00    1400.
RE DISCCART     405.63     69.59   1400.00    1400.
RE DISCCART     337.71     -8.29   1400.00    1400.
RE DISCCART     244.77    -55.12   1400.00    1400.
RE DISCCART     152.08   -102.54   1400.00    1400.
RE DISCCART      53.15   -132.88   1400.00    1400.
RE DISCCART     -48.48   -155.28   1400.00    1400.
RE DISCCART    -151.63   -169.15   1400.00    1400.
RE DISCCART    -253.71   -189.72   1400.00    1400.
RE DISCCART    -354.07   -217.34   1400.00    1400.
RE DISCCART    -450.53   -194.01   1400.00    1400.
RE DISCCART    -460.63   -106.35   1400.00    1400.

RE FINISHED

ME STARTING
   SURFFILE  SURFACE  FREE
   PROFFILE  PROFILE  FREE
   SURFDATA  99999  1994  Tower/Sodar
   UAIRDATA  99999  1994  Tower/Sodar
```

```
                    ** Montour Alongwind Hill
                 ** High Stack Height: 150 meters
        ** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
                 ** Close to Hill: 1 km away
             ** Meteorology from 100-m Tower and Sodar

   SITEDATA  00000  1994  Tower/Sodar
   PROFBASE 0
ME FINISHED

OU STARTING
   RECTABLE  ALLAVE  FIRST-SECOND
OU FINISHED
```

```
                    ** Montour Alongwind Hill
                ** High Stack Height: 150 meters
        ** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
                    ** Far from Hill: 10 km away
            ** Meteorology from 100-m Tower and Sodar

** Montour Alongwind Hill
** High Stack Height: 150 meters
** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
** Far from Hill: 10 km away
** Meteorology from 100-m Tower and Sodar
**
CO STARTING
   TITLEONE  Montour Alongwind Hill: Source 10 km away
   TITLETWO  150-m Stack Height; Low Buoyancy Case
   MODELOPT  CONC             MSGPRO
   AVERTIME  1 3 24 Period
   POLLUTID  SO2
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
**   TERRHGTS  ELEV
CO FINISHED

SO STARTING
   ELEVUNIT  FEET
   LOCATION  STACK1  POINT  -12500.0   0.0   700.0
** Point Source       QS    HS    TS    VS   DS
** Parameters:       ----  ----  ----  ----  ---
   SRCPARAM  STACK1    1.  150.  400.  10.0  2.0

   SRCGROUP  ALL
SO FINISHED

RE STARTING
RE ELEVUNIT    FEET
**RE DISCCART    5151.00    390.00    800.00    1400.[19]
**RE DISCCART    4531.46    -60.49    800.00    1400.
**RE DISCCART    3756.52   -233.28    800.00    1400.
**RE DISCCART    3193.14    -42.10    800.00    1400.
**RE DISCCART    2708.92   -488.69    800.00    1400.
**RE DISCCART    1899.55   -738.38    800.00    1400.
**RE DISCCART    1495.27   -736.13    800.00    1400.
**RE DISCCART     451.18  -1149.47    800.00    1400.
**RE DISCCART     -87.14  -1069.58    800.00    1400.
**RE DISCCART   -1184.02  -1467.76    800.00    1400.
**RE DISCCART   -1206.48  -1152.95    800.00    1400.
**RE DISCCART   -2342.48   -720.47    800.00    1400.
**RE DISCCART   -1815.80    157.59    800.00    1400.
**RE DISCCART    -655.12    645.66    800.00    1400.
**RE DISCCART     566.85    934.26    800.00    1400.
**RE DISCCART    1815.48   1083.97    800.00    1400.
**RE DISCCART    3055.76   1208.49    800.00    1400.
**RE DISCCART    3391.81   1562.14    800.00    1400.
**RE DISCCART    3901.96   1746.68    800.00    1400.
**RE DISCCART    4661.76   1962.20    800.00    1400.
**RE DISCCART    5166.00    608.00    900.00    1400.
**RE DISCCART    4336.52    340.43    900.00    1400.
**RE DISCCART    3522.66    157.12    900.00    1400.
**RE DISCCART    2660.46     32.61    900.00    1400.
**RE DISCCART    1842.27   -256.35    900.00    1400.
**RE DISCCART    1059.77   -603.44    900.00    1400.
```

[19] The data lines marked with the "**" are receptors used for the low stack heights (30m) but not used for the high stack heights (150m).

```
                    ** Montour Alongwind Hill
                 ** High Stack Height: 150 meters
        ** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
                    ** Far from Hill: 10 km away
              ** Meteorology from 100-m Tower and Sodar

**RE DISCCART    1171.93   -809.29    900.00    1400.
**RE DISCCART     680.73  -1007.03    900.00    1400.
**RE DISCCART    -127.60   -939.83    900.00    1400.
**RE DISCCART    -820.39  -1311.66    900.00    1400.
**RE DISCCART   -1293.17   -962.38    900.00    1400.
**RE DISCCART   -2135.70   -746.90    900.00    1400.
**RE DISCCART   -1987.28    -70.91    900.00    1400.
**RE DISCCART   -1219.15    337.75    900.00    1400.
**RE DISCCART    -402.59    646.87    900.00    1400.
**RE DISCCART     448.93    798.78    900.00    1400.
**RE DISCCART    1315.11    876.65    900.00    1400.
**RE DISCCART    2165.93   1048.41    900.00    1400.
**RE DISCCART    3028.58   1139.92    900.00    1400.
**RE DISCCART    3884.88   1274.68    900.00    1400.
**RE DISCCART    5098.00    693.00   1000.00    1400.
**RE DISCCART    4384.83    469.68   1000.00    1400.
**RE DISCCART    3648.04    363.24   1000.00    1400.
**RE DISCCART    2921.62    191.68   1000.00    1400.
**RE DISCCART    2197.11     45.32   1000.00    1400.
**RE DISCCART    1492.91   -205.21   1000.00    1400.
**RE DISCCART     805.11   -496.92   1000.00    1400.
**RE DISCCART      89.87   -703.05   1000.00    1400.
**RE DISCCART    -642.06   -839.00   1000.00    1400.
**RE DISCCART   -1389.53   -833.49   1000.00    1400.
**RE DISCCART   -2087.11   -609.10   1000.00    1400.
**RE DISCCART   -1759.10    -27.47   1000.00    1400.
**RE DISCCART   -1089.79    298.80   1000.00    1400.
**RE DISCCART    -380.89    535.48   1000.00    1400.
**RE DISCCART     344.93    701.43   1000.00    1400.
**RE DISCCART    1085.83    759.47   1000.00    1400.
**RE DISCCART    1824.18    855.77   1000.00    1400.
**RE DISCCART    2555.99   1001.84   1000.00    1400.
**RE DISCCART    3291.01   1072.32   1000.00    1400.
**RE DISCCART    4023.03   1161.59   1000.00    1400.
**RE DISCCART    4952.00    785.00   1100.00    1400.
**RE DISCCART    4289.30    566.42   1100.00    1400.
**RE DISCCART    3583.69    469.90   1100.00    1400.
**RE DISCCART    2904.20    315.43   1100.00    1400.
**RE DISCCART    2205.43    178.62   1100.00    1400.
**RE DISCCART    1553.80    -82.14   1100.00    1400.
**RE DISCCART     881.25   -311.24   1100.00    1400.
**RE DISCCART     198.55   -506.91   1100.00    1400.
**RE DISCCART    -493.47   -638.49   1100.00    1400.
**RE DISCCART   -1201.37   -713.78   1100.00    1400.
**RE DISCCART   -1869.93   -507.27   1100.00    1400.
**RE DISCCART   -1464.60      -.34   1100.00    1400.
**RE DISCCART    -827.13    314.43   1100.00    1400.
**RE DISCCART    -135.85    488.72   1100.00    1400.
**RE DISCCART     563.35    607.51   1100.00    1400.
**RE DISCCART    1273.30    645.20   1100.00    1400.
**RE DISCCART    1965.33    791.11   1100.00    1400.
**RE DISCCART    2666.34    910.29   1100.00    1400.
**RE DISCCART    3370.16   1003.41   1100.00    1400.
**RE DISCCART    4070.69   1120.04   1100.00    1400.
RE DISCCART    1655.00    146.00   1200.00    1400.
RE DISCCART    1075.54    -98.85   1200.00    1400.
RE DISCCART     481.15   -308.48   1200.00    1400.
RE DISCCART    -125.99   -475.98   1200.00    1400.
RE DISCCART    -747.97   -576.12   1200.00    1400.
```

** Montour Alongwind Hill
** High Stack Height: 150 meters
** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
** Far from Hill: 10 km away
** Meteorology from 100-m Tower and Sodar

```
RE DISCCART   -1367.68   -518.96   1200.00    1400.
RE DISCCART   -1332.89    -67.94   1200.00    1400.
RE DISCCART    -761.22    195.56   1200.00    1400.
RE DISCCART    -149.69    347.21   1200.00    1400.
RE DISCCART     465.45    485.10   1200.00    1400.
RE DISCCART    1093.57    506.82   1200.00    1400.
RE DISCCART    1712.61    443.97   1200.00    1400.
RE DISCCART    2281.57    691.14   1200.00    1400.
RE DISCCART    2905.52    783.48   1200.00    1400.
RE DISCCART    3514.58    925.91   1200.00    1400.
RE DISCCART    4142.81    947.59   1200.00    1400.
RE DISCCART    4040.15    665.33   1200.00    1400.
RE DISCCART    3413.23    607.18   1200.00    1400.
RE DISCCART    2851.31    427.99   1200.00    1400.
RE DISCCART    2224.11    416.49   1200.00    1400.
RE DISCCART     141.00   -299.00   1300.00    1400.
RE DISCCART    -108.32   -341.14   1300.00    1400.
RE DISCCART    -358.91   -376.51   1300.00    1400.
RE DISCCART    -607.97   -421.69   1300.00    1400.
RE DISCCART    -857.60   -453.09   1300.00    1400.
RE DISCCART   -1083.05   -366.88   1300.00    1400.
RE DISCCART   -1074.53   -137.83   1300.00    1400.
RE DISCCART    -875.96     10.86   1300.00    1400.
RE DISCCART    -637.92     95.96   1300.00    1400.
RE DISCCART    -395.29    168.10   1300.00    1400.
RE DISCCART    -152.75    240.59   1300.00    1400.
RE DISCCART      92.72    301.83   1300.00    1400.
RE DISCCART     342.50    342.65   1300.00    1400.
RE DISCCART     592.42    378.00   1300.00    1400.
RE DISCCART     843.23    366.02   1300.00    1400.
RE DISCCART    1081.96    287.07   1300.00    1400.
RE DISCCART    1102.55     95.11   1300.00    1400.
RE DISCCART     886.71    -29.07   1300.00    1400.
RE DISCCART     649.92   -118.37   1300.00    1400.
RE DISCCART     420.08   -223.10   1300.00    1400.
RE DISCCART    -373.00    -31.00   1400.00    1400.
RE DISCCART    -287.24     27.50   1400.00    1400.
RE DISCCART    -188.10     58.73   1400.00    1400.
RE DISCCART     -89.24     90.31   1400.00    1400.
RE DISCCART       9.09    119.15   1400.00    1400.
RE DISCCART     113.04    125.22   1400.00    1400.
RE DISCCART     214.03    144.82   1400.00    1400.
RE DISCCART     311.84    177.82   1400.00    1400.
RE DISCCART     410.80    157.11   1400.00    1400.
RE DISCCART     405.63     69.59   1400.00    1400.
RE DISCCART     337.71     -8.29   1400.00    1400.
RE DISCCART     244.77    -55.12   1400.00    1400.
RE DISCCART     152.08   -102.54   1400.00    1400.
RE DISCCART      53.15   -132.88   1400.00    1400.
RE DISCCART     -48.48   -155.28   1400.00    1400.
RE DISCCART    -151.63   -169.15   1400.00    1400.
RE DISCCART    -253.71   -189.72   1400.00    1400.
RE DISCCART    -354.07   -217.34   1400.00    1400.
RE DISCCART    -450.53   -194.01   1400.00    1400.
RE DISCCART    -460.63   -106.35   1400.00    1400.

RE FINISHED

ME STARTING
```

```
                    ** Montour Alongwind Hill
                ** High Stack Height: 150 meters
        ** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
                ** Far from Hill: 10 km away
            ** Meteorology from 100-m Tower and Sodar

   SURFFILE  SURFACE  FREE
   PROFFILE  PROFILE  FREE
   SURFDATA  99999  1994  Tower/Sodar
   UAIRDATA  99999  1994  Tower/Sodar
   SITEDATA  00000  1994  Tower/Sodar
   PROFBASE 0
ME FINISHED

OU STARTING
   RECTABLE  ALLAVE  FIRST-SECOND
OU FINISHED
```

```
                    ** Montour Crosswind Hill
                ** High Stack Height: 150 meters
        ** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
                ** Close to Hill: 1 km away
            ** Meteorology from 100-m Tower and Sodar

** Montour Crosswind Hill
** High Stack Height: 150 meters
** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
** Close to Hill: 1 km away
** Meteorology from 100-m Tower and Sodar
**
CO STARTING
   TITLEONE  Montour Crosswind Hill: Source 1 km away
   TITLETWO  150-m Stack Height; Low Buoyancy Case
   MODELOPT  CONC             MSGPRO
   AVERTIME  1 3 24 Period
   POLLUTID  SO2
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
**   TERRHGTS  ELEV
CO FINISHED

SO STARTING
   ELEVUNIT  FEET
   LOCATION  STACK1  POINT  0.0   2000.0   700.0
** Point Source       QS    HS    TS    VS   DS
** Parameters:       ----  ----  ----  ----  ---
   SRCPARAM  STACK1    1.  150.  400.  10.0  2.0

   SRCGROUP  ALL
SO FINISHED

RE STARTING
RE ELEVUNIT    FEET
**RE DISCCART    5151.00    390.00    800.00    1400.[20]
**RE DISCCART    4531.46    -60.49    800.00    1400.
**RE DISCCART    3756.52   -233.28    800.00    1400.
**RE DISCCART    3193.14    -42.10    800.00    1400.
**RE DISCCART    2708.92   -488.69    800.00    1400.
**RE DISCCART    1899.55   -738.38    800.00    1400.
**RE DISCCART    1495.27   -736.13    800.00    1400.
**RE DISCCART     451.18  -1149.47    800.00    1400.
**RE DISCCART     -87.14  -1069.58    800.00    1400.
**RE DISCCART   -1184.02  -1467.76    800.00    1400.
**RE DISCCART   -1206.48  -1152.95    800.00    1400.
**RE DISCCART   -2342.48   -720.47    800.00    1400.
**RE DISCCART   -1815.80    157.59    800.00    1400.
**RE DISCCART    -655.12    645.66    800.00    1400.
**RE DISCCART     566.85    934.26    800.00    1400.
**RE DISCCART    1815.48   1083.97    800.00    1400.
**RE DISCCART    3055.76   1208.49    800.00    1400.
**RE DISCCART    3391.81   1562.14    800.00    1400.
**RE DISCCART    3901.96   1746.68    800.00    1400.
**RE DISCCART    4661.76   1962.20    800.00    1400.
**RE DISCCART    5166.00    608.00    900.00    1400.
**RE DISCCART    4336.52    340.43    900.00    1400.
**RE DISCCART    3522.66    157.12    900.00    1400.
**RE DISCCART    2660.46     32.61    900.00    1400.
**RE DISCCART    1842.27   -256.35    900.00    1400.
**RE DISCCART    1059.77   -603.44    900.00    1400.
```

[20] The data lines marked with the "**" are receptors used for the low stack heights (30m) but not used for the high stack heights (150m).

** Montour Crosswind Hill
** High Stack Height: 150 meters
** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
** Close to Hill: 1 km away
** Meteorology from 100-m Tower and Sodar

```
**RE DISCCART    1171.93   -809.29    900.00    1400.
**RE DISCCART     680.73  -1007.03    900.00    1400.
**RE DISCCART    -127.60   -939.83    900.00    1400.
**RE DISCCART    -820.39  -1311.66    900.00    1400.
**RE DISCCART   -1293.17   -962.38    900.00    1400.
**RE DISCCART   -2135.70   -746.90    900.00    1400.
**RE DISCCART   -1987.28    -70.91    900.00    1400.
**RE DISCCART   -1219.15    337.75    900.00    1400.
**RE DISCCART    -402.59    646.87    900.00    1400.
**RE DISCCART     448.93    798.78    900.00    1400.
**RE DISCCART    1315.11    876.65    900.00    1400.
**RE DISCCART    2165.93   1048.41    900.00    1400.
**RE DISCCART    3028.58   1139.92    900.00    1400.
**RE DISCCART    3884.88   1274.68    900.00    1400.
**RE DISCCART    5098.00    693.00   1000.00    1400.
**RE DISCCART    4384.83    469.68   1000.00    1400.
**RE DISCCART    3648.04    363.24   1000.00    1400.
**RE DISCCART    2921.62    191.68   1000.00    1400.
**RE DISCCART    2197.11     45.32   1000.00    1400.
**RE DISCCART    1492.91   -205.21   1000.00    1400.
**RE DISCCART     805.11   -496.92   1000.00    1400.
**RE DISCCART      89.87   -703.05   1000.00    1400.
**RE DISCCART    -642.06   -839.00   1000.00    1400.
**RE DISCCART   -1389.53   -833.49   1000.00    1400.
**RE DISCCART   -2087.11   -609.10   1000.00    1400.
**RE DISCCART   -1759.10    -27.47   1000.00    1400.
**RE DISCCART   -1089.79    298.80   1000.00    1400.
**RE DISCCART    -380.89    535.48   1000.00    1400.
**RE DISCCART     344.93    701.43   1000.00    1400.
**RE DISCCART    1085.83    759.47   1000.00    1400.
**RE DISCCART    1824.18    855.77   1000.00    1400.
**RE DISCCART    2555.99   1001.84   1000.00    1400.
**RE DISCCART    3291.01   1072.32   1000.00    1400.
**RE DISCCART    4023.03   1161.59   1000.00    1400.
**RE DISCCART    4952.00    785.00   1100.00    1400.
**RE DISCCART    4289.30    566.42   1100.00    1400.
**RE DISCCART    3583.69    469.90   1100.00    1400.
**RE DISCCART    2904.20    315.43   1100.00    1400.
**RE DISCCART    2205.43    178.62   1100.00    1400.
**RE DISCCART    1553.80    -82.14   1100.00    1400.
**RE DISCCART     881.25   -311.24   1100.00    1400.
**RE DISCCART     198.55   -506.91   1100.00    1400.
**RE DISCCART    -493.47   -638.49   1100.00    1400.
**RE DISCCART   -1201.37   -713.78   1100.00    1400.
**RE DISCCART   -1869.93   -507.27   1100.00    1400.
**RE DISCCART   -1464.60      -.34   1100.00    1400.
**RE DISCCART    -827.13    314.43   1100.00    1400.
**RE DISCCART    -135.85    488.72   1100.00    1400.
**RE DISCCART     563.35    607.51   1100.00    1400.
**RE DISCCART    1273.30    645.20   1100.00    1400.
**RE DISCCART    1965.33    791.11   1100.00    1400.
**RE DISCCART    2666.34    910.29   1100.00    1400.
**RE DISCCART    3370.16   1003.41   1100.00    1400.
**RE DISCCART    4070.69   1120.04   1100.00    1400.
RE DISCCART    1655.00    146.00   1200.00    1400.
RE DISCCART    1075.54    -98.85   1200.00    1400.
RE DISCCART     481.15   -308.48   1200.00    1400.
RE DISCCART    -125.99   -475.98   1200.00    1400.
RE DISCCART    -747.97   -576.12   1200.00    1400.
```

```
                    ** Montour Crosswind Hill
                 ** High Stack Height: 150 meters
        ** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
                    ** Close to Hill: 1 km away
              ** Meteorology from 100-m Tower and Sodar

RE DISCCART   -1367.68   -518.96   1200.00    1400.
RE DISCCART   -1332.89    -67.94   1200.00    1400.
RE DISCCART    -761.22    195.56   1200.00    1400.
RE DISCCART    -149.69    347.21   1200.00    1400.
RE DISCCART     465.45    485.10   1200.00    1400.
RE DISCCART    1093.57    506.82   1200.00    1400.
RE DISCCART    1712.61    443.97   1200.00    1400.
RE DISCCART    2281.57    691.14   1200.00    1400.
RE DISCCART    2905.52    783.48   1200.00    1400.
RE DISCCART    3514.58    925.91   1200.00    1400.
RE DISCCART    4142.81    947.59   1200.00    1400.
RE DISCCART    4040.15    665.33   1200.00    1400.
RE DISCCART    3413.23    607.18   1200.00    1400.
RE DISCCART    2851.31    427.99   1200.00    1400.
RE DISCCART    2224.11    416.49   1200.00    1400.
RE DISCCART     141.00   -299.00   1300.00    1400.
RE DISCCART    -108.32   -341.14   1300.00    1400.
RE DISCCART    -358.91   -376.51   1300.00    1400.
RE DISCCART    -607.97   -421.69   1300.00    1400.
RE DISCCART    -857.60   -453.09   1300.00    1400.
RE DISCCART   -1083.05   -366.88   1300.00    1400.
RE DISCCART   -1074.53   -137.83   1300.00    1400.
RE DISCCART    -875.96     10.86   1300.00    1400.
RE DISCCART    -637.92     95.96   1300.00    1400.
RE DISCCART    -395.29    168.10   1300.00    1400.
RE DISCCART    -152.75    240.59   1300.00    1400.
RE DISCCART      92.72    301.83   1300.00    1400.
RE DISCCART     342.50    342.65   1300.00    1400.
RE DISCCART     592.42    378.00   1300.00    1400.
RE DISCCART     843.23    366.02   1300.00    1400.
RE DISCCART    1081.96    287.07   1300.00    1400.
RE DISCCART    1102.55     95.11   1300.00    1400.
RE DISCCART     886.71    -29.07   1300.00    1400.
RE DISCCART     649.92   -118.37   1300.00    1400.
RE DISCCART     420.08   -223.10   1300.00    1400.
RE DISCCART    -373.00    -31.00   1400.00    1400.
RE DISCCART    -287.24     27.50   1400.00    1400.
RE DISCCART    -188.10     58.73   1400.00    1400.
RE DISCCART     -89.24     90.31   1400.00    1400.
RE DISCCART       9.09    119.15   1400.00    1400.
RE DISCCART     113.04    125.22   1400.00    1400.
RE DISCCART     214.03    144.82   1400.00    1400.
RE DISCCART     311.84    177.82   1400.00    1400.
RE DISCCART     410.80    157.11   1400.00    1400.
RE DISCCART     405.63     69.59   1400.00    1400.
RE DISCCART     337.71     -8.29   1400.00    1400.
RE DISCCART     244.77    -55.12   1400.00    1400.
RE DISCCART     152.08   -102.54   1400.00    1400.
RE DISCCART      53.15   -132.88   1400.00    1400.
RE DISCCART     -48.48   -155.28   1400.00    1400.
RE DISCCART    -151.63   -169.15   1400.00    1400.
RE DISCCART    -253.71   -189.72   1400.00    1400.
RE DISCCART    -354.07   -217.34   1400.00    1400.
RE DISCCART    -450.53   -194.01   1400.00    1400.
RE DISCCART    -460.63   -106.35   1400.00    1400.

RE FINISHED

ME STARTING
```

```
                    ** Montour Crosswind Hill
                 ** High Stack Height: 150 meters
        ** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
                  ** Close to Hill: 1 km away
             ** Meteorology from 100-m Tower and Sodar

   SURFFILE  SURFACE  FREE
   PROFFILE  PROFILE  FREE
   SURFDATA  99999  1994  Tower/Sodar
   UAIRDATA  99999  1994  Tower/Sodar
   SITEDATA  00000  1994  Tower/Sodar
   PROFBASE 0
ME FINISHED

OU STARTING
   RECTABLE  ALLAVE  FIRST-SECOND
OU FINISHED
```

```
                    ** Montour Crosswind Hill
                ** High Stack Height: 150 meters
        ** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
                    ** Far from Hill: 10 km away
            ** Meteorology from 100-m Tower and Sodar

** Montour Crosswind Hill
** High Stack Height: 150 meters
** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
** Far from Hill: 10 km away
** Meteorology from 100-m Tower and Sodar
**
CO STARTING
   TITLEONE  Montour Crosswind Hill: Source 10 km away
   TITLETWO  150-m Stack Height; Low Buoyancy Case
   MODELOPT  CONC             MSGPRO
   AVERTIME  1 3 24 Period
   POLLUTID  SO2
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
**   TERRHGTS  ELEV
CO FINISHED

SO STARTING
   ELEVUNIT  FEET
   LOCATION  STACK1  POINT  0.0   11000.0   700.0
** Point Source       QS    HS    TS    VS   DS
** Parameters:       ----  ----  ----  ----  ---
   SRCPARAM  STACK1    1.  150.  400.  10.0  2.0

   SRCGROUP  ALL
SO FINISHED

RE STARTING
RE ELEVUNIT    FEET
**RE DISCCART    5151.00    390.00    800.00    1400.
**RE DISCCART    4531.46    -60.49    800.00    1400.
**RE DISCCART    3756.52   -233.28    800.00    1400.
**RE DISCCART    3193.14    -42.10    800.00    1400.
**RE DISCCART    2708.92   -488.69    800.00    1400.
**RE DISCCART    1899.55   -738.38    800.00    1400.
**RE DISCCART    1495.27   -736.13    800.00    1400.
**RE DISCCART     451.18  -1149.47    800.00    1400.
**RE DISCCART     -87.14  -1069.58    800.00    1400.
**RE DISCCART   -1184.02  -1467.76    800.00    1400.
**RE DISCCART   -1206.48  -1152.95    800.00    1400.
**RE DISCCART   -2342.48   -720.47    800.00    1400.
**RE DISCCART   -1815.80    157.59    800.00    1400.
**RE DISCCART    -655.12    645.66    800.00    1400.
**RE DISCCART     566.85    934.26    800.00    1400.
**RE DISCCART    1815.48   1083.97    800.00    1400.
**RE DISCCART    3055.76   1208.49    800.00    1400.
**RE DISCCART    3391.81   1562.14    800.00    1400.
**RE DISCCART    3901.96   1746.68    800.00    1400.
**RE DISCCART    4661.76   1962.20    800.00    1400.
**RE DISCCART    5166.00    608.00    900.00    1400.
**RE DISCCART    4336.52    340.43    900.00    1400.
**RE DISCCART    3522.66    157.12    900.00    1400.
**RE DISCCART    2660.46     32.61    900.00    1400.
**RE DISCCART    1842.27   -256.35    900.00    1400.
**RE DISCCART    1059.77   -603.44    900.00    1400.
```

[21]

[21] The data lines marked with the "**" are receptors used for the low stack heights (30m) but not used for the high stack heights (150m).

** Montour Crosswind Hill
** High Stack Height: 150 meters
** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
** Far from Hill: 10 km away
** Meteorology from 100-m Tower and Sodar

```
**RE DISCCART    1171.93   -809.29    900.00    1400.
**RE DISCCART     680.73  -1007.03    900.00    1400.
**RE DISCCART    -127.60   -939.83    900.00    1400.
**RE DISCCART    -820.39  -1311.66    900.00    1400.
**RE DISCCART   -1293.17   -962.38    900.00    1400.
**RE DISCCART   -2135.70   -746.90    900.00    1400.
**RE DISCCART   -1987.28    -70.91    900.00    1400.
**RE DISCCART   -1219.15    337.75    900.00    1400.
**RE DISCCART    -402.59    646.87    900.00    1400.
**RE DISCCART     448.93    798.78    900.00    1400.
**RE DISCCART    1315.11    876.65    900.00    1400.
**RE DISCCART    2165.93   1048.41    900.00    1400.
**RE DISCCART    3028.58   1139.92    900.00    1400.
**RE DISCCART    3884.88   1274.68    900.00    1400.
**RE DISCCART    5098.00    693.00   1000.00    1400.
**RE DISCCART    4384.83    469.68   1000.00    1400.
**RE DISCCART    3648.04    363.24   1000.00    1400.
**RE DISCCART    2921.62    191.68   1000.00    1400.
**RE DISCCART    2197.11     45.32   1000.00    1400.
**RE DISCCART    1492.91   -205.21   1000.00    1400.
**RE DISCCART     805.11   -496.92   1000.00    1400.
**RE DISCCART      89.87   -703.05   1000.00    1400.
**RE DISCCART    -642.06   -839.00   1000.00    1400.
**RE DISCCART   -1389.53   -833.49   1000.00    1400.
**RE DISCCART   -2087.11   -609.10   1000.00    1400.
**RE DISCCART   -1759.10    -27.47   1000.00    1400.
**RE DISCCART   -1089.79    298.80   1000.00    1400.
**RE DISCCART    -380.89    535.48   1000.00    1400.
**RE DISCCART     344.93    701.43   1000.00    1400.
**RE DISCCART    1085.83    759.47   1000.00    1400.
**RE DISCCART    1824.18    855.77   1000.00    1400.
**RE DISCCART    2555.99   1001.84   1000.00    1400.
**RE DISCCART    3291.01   1072.32   1000.00    1400.
**RE DISCCART    4023.03   1161.59   1000.00    1400.
**RE DISCCART    4952.00    785.00   1100.00    1400.
**RE DISCCART    4289.30    566.42   1100.00    1400.
**RE DISCCART    3583.69    469.90   1100.00    1400.
**RE DISCCART    2904.20    315.43   1100.00    1400.
**RE DISCCART    2205.43    178.62   1100.00    1400.
**RE DISCCART    1553.80    -82.14   1100.00    1400.
**RE DISCCART     881.25   -311.24   1100.00    1400.
**RE DISCCART     198.55   -506.91   1100.00    1400.
**RE DISCCART    -493.47   -638.49   1100.00    1400.
**RE DISCCART   -1201.37   -713.78   1100.00    1400.
**RE DISCCART   -1869.93   -507.27   1100.00    1400.
**RE DISCCART   -1464.60      -.34   1100.00    1400.
**RE DISCCART    -827.13    314.43   1100.00    1400.
**RE DISCCART    -135.85    488.72   1100.00    1400.
**RE DISCCART     563.35    607.51   1100.00    1400.
**RE DISCCART    1273.30    645.20   1100.00    1400.
**RE DISCCART    1965.33    791.11   1100.00    1400.
**RE DISCCART    2666.34    910.29   1100.00    1400.
**RE DISCCART    3370.16   1003.41   1100.00    1400.
**RE DISCCART    4070.69   1120.04   1100.00    1400.
RE DISCCART    1655.00    146.00   1200.00    1400.
RE DISCCART    1075.54    -98.85   1200.00    1400.
RE DISCCART     481.15   -308.48   1200.00    1400.
RE DISCCART    -125.99   -475.98   1200.00    1400.
RE DISCCART    -747.97   -576.12   1200.00    1400.
```

** Montour Crosswind Hill
** High Stack Height: 150 meters
** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
** Far from Hill: 10 km away
** Meteorology from 100-m Tower and Sodar

```
RE DISCCART   -1367.68   -518.96   1200.00    1400.
RE DISCCART   -1332.89    -67.94   1200.00    1400.
RE DISCCART    -761.22    195.56   1200.00    1400.
RE DISCCART    -149.69    347.21   1200.00    1400.
RE DISCCART     465.45    485.10   1200.00    1400.
RE DISCCART    1093.57    506.82   1200.00    1400.
RE DISCCART    1712.61    443.97   1200.00    1400.
RE DISCCART    2281.57    691.14   1200.00    1400.
RE DISCCART    2905.52    783.48   1200.00    1400.
RE DISCCART    3514.58    925.91   1200.00    1400.
RE DISCCART    4142.81    947.59   1200.00    1400.
RE DISCCART    4040.15    665.33   1200.00    1400.
RE DISCCART    3413.23    607.18   1200.00    1400.
RE DISCCART    2851.31    427.99   1200.00    1400.
RE DISCCART    2224.11    416.49   1200.00    1400.
RE DISCCART     141.00   -299.00   1300.00    1400.
RE DISCCART    -108.32   -341.14   1300.00    1400.
RE DISCCART    -358.91   -376.51   1300.00    1400.
RE DISCCART    -607.97   -421.69   1300.00    1400.
RE DISCCART    -857.60   -453.09   1300.00    1400.
RE DISCCART   -1083.05   -366.88   1300.00    1400.
RE DISCCART   -1074.53   -137.83   1300.00    1400.
RE DISCCART    -875.96     10.86   1300.00    1400.
RE DISCCART    -637.92     95.96   1300.00    1400.
RE DISCCART    -395.29    168.10   1300.00    1400.
RE DISCCART    -152.75    240.59   1300.00    1400.
RE DISCCART      92.72    301.83   1300.00    1400.
RE DISCCART     342.50    342.65   1300.00    1400.
RE DISCCART     592.42    378.00   1300.00    1400.
RE DISCCART     843.23    366.02   1300.00    1400.
RE DISCCART    1081.96    287.07   1300.00    1400.
RE DISCCART    1102.55     95.11   1300.00    1400.
RE DISCCART     886.71    -29.07   1300.00    1400.
RE DISCCART     649.92   -118.37   1300.00    1400.
RE DISCCART     420.08   -223.10   1300.00    1400.
RE DISCCART    -373.00    -31.00   1400.00    1400.
RE DISCCART    -287.24     27.50   1400.00    1400.
RE DISCCART    -188.10     58.73   1400.00    1400.
RE DISCCART     -89.24     90.31   1400.00    1400.
RE DISCCART       9.09    119.15   1400.00    1400.
RE DISCCART     113.04    125.22   1400.00    1400.
RE DISCCART     214.03    144.82   1400.00    1400.
RE DISCCART     311.84    177.82   1400.00    1400.
RE DISCCART     410.80    157.11   1400.00    1400.
RE DISCCART     405.63     69.59   1400.00    1400.
RE DISCCART     337.71     -8.29   1400.00    1400.
RE DISCCART     244.77    -55.12   1400.00    1400.
RE DISCCART     152.08   -102.54   1400.00    1400.
RE DISCCART      53.15   -132.88   1400.00    1400.
RE DISCCART     -48.48   -155.28   1400.00    1400.
RE DISCCART    -151.63   -169.15   1400.00    1400.
RE DISCCART    -253.71   -189.72   1400.00    1400.
RE DISCCART    -354.07   -217.34   1400.00    1400.
RE DISCCART    -450.53   -194.01   1400.00    1400.
RE DISCCART    -460.63   -106.35   1400.00    1400.

RE FINISHED

ME STARTING
```

```
                    ** Montour Crosswind Hill
                 ** High Stack Height: 150 meters
        ** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
                 ** Far from Hill: 10 km away
              ** Meteorology from 100-m Tower and Sodar

   SURFFILE  SURFACE  FREE
   PROFFILE  PROFILE  FREE
   SURFDATA  99999  1994  Tower/Sodar
   UAIRDATA  99999  1994  Tower/Sodar
   SITEDATA  00000  1994  Tower/Sodar
   PROFBASE 0
ME FINISHED

OU STARTING
   RECTABLE  ALLAVE  FIRST-SECOND
OU FINISHED
```

```
                    ** Piedmont Hill
              ** High Stack Height: 150 meters
     ** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
                  ** Close to Hill: 1 km away
            ** Meteorology from 100-m Tower and Sodar

** Piedmont Hill
** High Stack Height: 150 meters
** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
** Close to Hill: 1 km away
** Meteorology from 100-m Tower and Sodar
**
CO STARTING
   TITLEONE  Piedmont Hill: Source 1 km away
   TITLETWO  150-m Stack Height; Low Buoyancy Case
   MODELOPT  CONC             MSGPRO
   AVERTIME  1 3 24 Period
   POLLUTID  SO2
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
**   TERRHGTS  ELEV
CO FINISHED

SO STARTING
   ELEVUNIT  FEET
   LOCATION  STACK1  POINT  0.0   1000.0   1000.0
** Point Source       QS    HS    TS    VS   DS
** Parameters:       ----  ----  ----  ----  ---
   SRCPARAM  STACK1    1.  150.  400.  10.0  2.0

   SRCGROUP  ALL
SO FINISHED

RE STARTING
RE ELEVUNIT    FEET
**RE DISCCART   -672.70   -310.20   1100.00    2200.00[22]
**RE DISCCART   -460.34   -188.27   1100.00    2200.00
**RE DISCCART   -163.56   -285.58   1100.00    2200.00
**RE DISCCART    135.55   -278.41   1100.00    2200.00
**RE DISCCART    286.44      1.64   1100.00    2200.00
**RE DISCCART    338.40    314.48   1100.00    2200.00
**RE DISCCART    496.81    565.75   1100.00    2200.00
**RE DISCCART    790.12    687.19   1100.00    2200.00
**RE DISCCART   1084.50    632.61   1100.00    2200.00
**RE DISCCART   1343.70    448.20   1100.00    2200.00
**RE DISCCART   1530.85    197.65   1100.00    2200.00
**RE DISCCART   1598.52   -111.26   1100.00    2200.00
**RE DISCCART   -673.70   -707.70   1200.00    2200.00
**RE DISCCART   -597.16   -378.98   1200.00    2200.00
**RE DISCCART   -293.05   -353.49   1200.00    2200.00
**RE DISCCART     42.95   -378.95   1200.00    2200.00
**RE DISCCART    243.70   -187.39   1200.00    2200.00
**RE DISCCART    362.93    128.51   1200.00    2200.00
**RE DISCCART    461.65    436.02   1200.00    2200.00
**RE DISCCART    767.52    579.49   1200.00    2200.00
**RE DISCCART   1071.70    526.28   1200.00    2200.00
**RE DISCCART   1335.00    315.99   1200.00    2200.00
**RE DISCCART   1545.88     54.23   1200.00    2200.00
**RE DISCCART   1413.56   -229.96   1200.00    2200.00
**RE DISCCART   -698.20  -1097.00   1300.00    2200.00
**RE DISCCART   -606.51   -749.83   1300.00    2200.00
```

[22] The data lines marked with the "**" are receptors used for the low stack heights (30m) but not used for the high stack heights (150m).

** Piedmont Hill
** High Stack Height: 150 meters
** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
** Close to Hill: 1 km away
** Meteorology from 100-m Tower and Sodar

```
**RE DISCCART   -523.69   -397.90   1300.00    2200.00
**RE DISCCART   -174.03   -405.59   1300.00    2200.00
**RE DISCCART    176.90   -450.41   1300.00    2200.00
**RE DISCCART    337.10   -146.28   1300.00    2200.00
**RE DISCCART    430.57    202.04   1300.00    2200.00
**RE DISCCART    655.38    460.62   1300.00    2200.00
**RE DISCCART    993.30    489.93   1300.00    2200.00
**RE DISCCART   1277.66    263.80   1300.00    2200.00
**RE DISCCART   1486.02    -23.18   1300.00    2200.00
**RE DISCCART   1295.32   -309.14   1300.00    2200.00
**RE DISCCART   -709.10  -1413.00   1400.00    2200.00
**RE DISCCART   -597.65  -1053.55   1400.00    2200.00
**RE DISCCART   -512.79   -715.47   1400.00    2200.00
**RE DISCCART   -343.77   -468.29   1400.00    2200.00
**RE DISCCART     32.11   -477.12   1400.00    2200.00
**RE DISCCART    302.91   -363.02   1400.00    2200.00
**RE DISCCART    415.68    -19.55   1400.00    2200.00
**RE DISCCART    612.75    295.44   1400.00    2200.00
**RE DISCCART    945.84    389.58   1400.00    2200.00
**RE DISCCART   1262.78    188.79   1400.00    2200.00
**RE DISCCART   1388.27   -128.48   1400.00    2200.00
**RE DISCCART   1139.53   -410.69   1400.00    2200.00
RE DISCCART   -612.40  -1792.00   1500.00    2200.00
RE DISCCART   -632.69  -1395.44   1500.00    2200.00
RE DISCCART   -495.55  -1025.07   1500.00    2200.00
RE DISCCART   -433.60   -668.18   1500.00    2200.00
RE DISCCART   -106.68   -522.37   1500.00    2200.00
RE DISCCART    245.80   -585.23   1500.00    2200.00
RE DISCCART    413.78   -230.98   1500.00    2200.00
RE DISCCART    553.12    138.16   1500.00    2200.00
RE DISCCART    882.78    337.97   1500.00    2200.00
RE DISCCART   1211.30    132.16   1500.00    2200.00
RE DISCCART   1277.72   -198.82   1500.00    2200.00
RE DISCCART   1032.05   -511.55   1500.00    2200.00
RE DISCCART   -582.60  -2015.00   1600.00    2200.00
RE DISCCART   -561.02  -1616.37   1600.00    2200.00
RE DISCCART   -479.65  -1223.82   1600.00    2200.00
RE DISCCART   -341.53   -863.47   1600.00    2200.00
RE DISCCART   -133.80   -612.84   1600.00    2200.00
RE DISCCART    242.75   -647.07   1600.00    2200.00
RE DISCCART    448.16   -311.09   1600.00    2200.00
RE DISCCART    592.43     59.94   1600.00    2200.00
RE DISCCART    918.60    238.86   1600.00    2200.00
RE DISCCART   1228.23      4.15   1600.00    2200.00
RE DISCCART   1088.95   -350.46   1600.00    2200.00
RE DISCCART    885.35   -698.68   1600.00    2200.00
RE DISCCART   -505.50  -2155.00   1700.00    2200.00
RE DISCCART   -480.41  -1760.47   1700.00    2200.00
RE DISCCART   -465.41  -1358.34   1700.00    2200.00
RE DISCCART   -310.06   -987.10   1700.00    2200.00
RE DISCCART   -138.32   -654.32   1700.00    2200.00
RE DISCCART    231.42   -710.58   1700.00    2200.00
RE DISCCART    469.14   -408.24   1700.00    2200.00
RE DISCCART    618.92    -32.23   1700.00    2200.00
RE DISCCART    944.57    168.79   1700.00    2200.00
RE DISCCART   1164.28   -117.76   1700.00    2200.00
RE DISCCART    962.35   -467.47   1700.00    2200.00
RE DISCCART    783.63   -831.20   1700.00    2200.00
RE DISCCART   -357.70  -2305.00   1800.00    2200.00
```

** Piedmont Hill
** High Stack Height: 150 meters
** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
** Close to Hill: 1 km away
** Meteorology from 100-m Tower and Sodar

RE DISCCART	-437.57	-1945.98	1800.00	2200.00
RE DISCCART	-369.41	-1566.25	1800.00	2200.00
RE DISCCART	-285.45	-1172.66	1800.00	2200.00
RE DISCCART	-166.77	-788.53	1800.00	2200.00
RE DISCCART	192.72	-801.51	1800.00	2200.00
RE DISCCART	486.38	-562.30	1800.00	2200.00
RE DISCCART	638.29	-189.10	1800.00	2200.00
RE DISCCART	945.65	31.54	1800.00	2200.00
RE DISCCART	1040.60	-246.59	1800.00	2200.00
RE DISCCART	845.76	-601.19	1800.00	2200.00
RE DISCCART	700.78	-978.55	1800.00	2200.00
RE DISCCART	-312.10	-2275.00	1900.00	2200.00
RE DISCCART	-352.85	-1926.16	1900.00	2200.00
RE DISCCART	-284.39	-1572.42	1900.00	2200.00
RE DISCCART	-219.41	-1204.49	1900.00	2200.00
RE DISCCART	-103.65	-845.19	1900.00	2200.00
RE DISCCART	231.54	-848.17	1900.00	2200.00
RE DISCCART	526.84	-634.35	1900.00	2200.00
RE DISCCART	675.48	-292.95	1900.00	2200.00
RE DISCCART	957.97	-77.44	1900.00	2200.00
RE DISCCART	856.22	-432.11	1900.00	2200.00
RE DISCCART	728.44	-787.98	1900.00	2200.00
RE DISCCART	646.54	-1155.69	1900.00	2200.00
RE DISCCART	-211.00	-2248.00	2000.00	2200.00
RE DISCCART	-208.98	-2019.81	2000.00	2200.00
RE DISCCART	-103.15	-1812.17	2000.00	2200.00
RE DISCCART	-133.27	-1588.07	2000.00	2200.00
RE DISCCART	-159.02	-1357.53	2000.00	2200.00
RE DISCCART	-71.30	-1142.46	2000.00	2200.00
RE DISCCART	67.68	-957.10	2000.00	2200.00
RE DISCCART	296.79	-912.52	2000.00	2200.00
RE DISCCART	524.56	-859.69	2000.00	2200.00
RE DISCCART	573.38	-1049.63	2000.00	2200.00
RE DISCCART	607.64	-1272.62	2000.00	2200.00
RE DISCCART	677.99	-1493.23	2000.00	2200.00
RE DISCCART	99.85	-2515.00	2100.00	2200.00
RE DISCCART	52.53	-2279.43	2100.00	2200.00
RE DISCCART	34.82	-2043.20	2100.00	2200.00
RE DISCCART	93.40	-1816.61	2100.00	2200.00
RE DISCCART	-9.02	-1599.99	2100.00	2200.00
RE DISCCART	2.67	-1394.18	2100.00	2200.00
RE DISCCART	127.68	-1190.55	2100.00	2200.00
RE DISCCART	276.83	-1010.06	2100.00	2200.00
RE DISCCART	443.05	-1102.06	2100.00	2200.00
RE DISCCART	421.80	-1337.79	2100.00	2200.00
RE DISCCART	613.92	-1451.98	2100.00	2200.00
RE DISCCART	643.13	-1689.91	2100.00	2200.00
RE DISCCART	348.70	-2665.00	2200.00	2200.00
RE DISCCART	323.75	-2501.71	2200.00	2200.00
RE DISCCART	375.69	-2350.23	2200.00	2200.00
RE DISCCART	308.07	-2194.93	2200.00	2200.00
RE DISCCART	340.42	-2038.55	2200.00	2200.00
RE DISCCART	409.93	-1883.47	2200.00	2200.00
RE DISCCART	387.04	-1722.33	2200.00	2200.00
RE DISCCART	296.38	-1584.62	2200.00	2200.00
RE DISCCART	440.59	-1521.57	2200.00	2200.00
RE DISCCART	552.40	-1613.29	2200.00	2200.00
RE DISCCART	606.70	-1773.86	2200.00	2200.00
RE DISCCART	666.27	-1932.25	2200.00	2200.00

```
                    ** Piedmont Hill
              ** High Stack Height: 150 meters
     ** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
              ** Close to Hill: 1 km away
          ** Meteorology from 100-m Tower and Sodar

RE FINISHED

ME STARTING
   SURFFILE  SURFACE  FREE
   PROFFILE  PROFILE  FREE
   SURFDATA  99999  1994  Tower/Sodar
   UAIRDATA  99999  1994  Tower/Sodar
   SITEDATA  00000  1994  Tower/Sodar
   PROFBASE 0
ME FINISHED

OU STARTING
   RECTABLE  ALLAVE  FIRST-SECOND
OU FINISHED
```

```
                    ** Piedmont Hill
            ** High Stack Height: 150 meters
** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
                    ** Far from Hill: 10 km away
          ** Meteorology from 100-m Tower and Sodar

** Piedmont Hill
** High Stack Height: 150 meters
** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
** Far from Hill: 10 km away
** Meteorology from 100-m Tower and Sodar
**
CO STARTING
   TITLEONE  Piedmont Hill: Source 10 km away
   TITLETWO  150-m Stack Height; Low Buoyancy Case
   MODELOPT  CONC             MSGPRO
   AVERTIME  1 3 24 Period
   POLLUTID  SO2
   RUNORNOT  RUN
   ERRORFIL  ERRORS.OUT
**   TERRHGTS  ELEV
CO FINISHED

SO STARTING
   ELEVUNIT  FEET
   LOCATION  STACK1  POINT  0.0   10000.0   1000.0
** Point Source       QS    HS    TS    VS   DS
** Parameters:       ----  ----  ----  ----  ---
   SRCPARAM  STACK1    1.  150.  400.  10.0  2.0

   SRCGROUP  ALL
SO FINISHED

RE STARTING
RE ELEVUNIT    FEET
**RE DISCCART   -672.70   -310.20   1100.00    2200.00 [23]
**RE DISCCART   -460.34   -188.27   1100.00    2200.00
**RE DISCCART   -163.56   -285.58   1100.00    2200.00
**RE DISCCART    135.55   -278.41   1100.00    2200.00
**RE DISCCART    286.44      1.64   1100.00    2200.00
**RE DISCCART    338.40    314.48   1100.00    2200.00
**RE DISCCART    496.81    565.75   1100.00    2200.00
**RE DISCCART    790.12    687.19   1100.00    2200.00
**RE DISCCART   1084.50    632.61   1100.00    2200.00
**RE DISCCART   1343.70    448.20   1100.00    2200.00
**RE DISCCART   1530.85    197.65   1100.00    2200.00
**RE DISCCART   1598.52   -111.26   1100.00    2200.00
**RE DISCCART   -673.70   -707.70   1200.00    2200.00
**RE DISCCART   -597.16   -378.98   1200.00    2200.00
**RE DISCCART   -293.05   -353.49   1200.00    2200.00
**RE DISCCART     42.95   -378.95   1200.00    2200.00
**RE DISCCART    243.70   -187.39   1200.00    2200.00
**RE DISCCART    362.93    128.51   1200.00    2200.00
**RE DISCCART    461.65    436.02   1200.00    2200.00
**RE DISCCART    767.52    579.49   1200.00    2200.00
**RE DISCCART   1071.70    526.28   1200.00    2200.00
**RE DISCCART   1335.00    315.99   1200.00    2200.00
**RE DISCCART   1545.88     54.23   1200.00    2200.00
**RE DISCCART   1413.56   -229.96   1200.00    2200.00
**RE DISCCART   -698.20  -1097.00   1300.00    2200.00
**RE DISCCART   -606.51   -749.83   1300.00    2200.00
```

[23] The data lines marked with the "**" are receptors used for the low stack heights (30m) but not used for the high stack heights (150m).

** Piedmont Hill
** High Stack Height: 150 meters
** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
** Far from Hill: 10 km away
** Meteorology from 100-m Tower and Sodar

```
**RE DISCCART   -523.69   -397.90   1300.00    2200.00
**RE DISCCART   -174.03   -405.59   1300.00    2200.00
**RE DISCCART    176.90   -450.41   1300.00    2200.00
**RE DISCCART    337.10   -146.28   1300.00    2200.00
**RE DISCCART    430.57    202.04   1300.00    2200.00
**RE DISCCART    655.38    460.62   1300.00    2200.00
**RE DISCCART    993.30    489.93   1300.00    2200.00
**RE DISCCART   1277.66    263.80   1300.00    2200.00
**RE DISCCART   1486.02    -23.18   1300.00    2200.00
**RE DISCCART   1295.32   -309.14   1300.00    2200.00
**RE DISCCART   -709.10  -1413.00   1400.00    2200.00
**RE DISCCART   -597.65  -1053.55   1400.00    2200.00
**RE DISCCART   -512.79   -715.47   1400.00    2200.00
**RE DISCCART   -343.77   -468.29   1400.00    2200.00
**RE DISCCART     32.11   -477.12   1400.00    2200.00
**RE DISCCART    302.91   -363.02   1400.00    2200.00
**RE DISCCART    415.68    -19.55   1400.00    2200.00
**RE DISCCART    612.75    295.44   1400.00    2200.00
**RE DISCCART    945.84    389.58   1400.00    2200.00
**RE DISCCART   1262.78    188.79   1400.00    2200.00
**RE DISCCART   1388.27   -128.48   1400.00    2200.00
**RE DISCCART   1139.53   -410.69   1400.00    2200.00
RE DISCCART   -612.40  -1792.00   1500.00    2200.00
RE DISCCART   -632.69  -1395.44   1500.00    2200.00
RE DISCCART   -495.55  -1025.07   1500.00    2200.00
RE DISCCART   -433.60   -668.18   1500.00    2200.00
RE DISCCART   -106.68   -522.37   1500.00    2200.00
RE DISCCART    245.80   -585.23   1500.00    2200.00
RE DISCCART    413.78   -230.98   1500.00    2200.00
RE DISCCART    553.12    138.16   1500.00    2200.00
RE DISCCART    882.78    337.97   1500.00    2200.00
RE DISCCART   1211.30    132.16   1500.00    2200.00
RE DISCCART   1277.72   -198.82   1500.00    2200.00
RE DISCCART   1032.05   -511.55   1500.00    2200.00
RE DISCCART   -582.60  -2015.00   1600.00    2200.00
RE DISCCART   -561.02  -1616.37   1600.00    2200.00
RE DISCCART   -479.65  -1223.82   1600.00    2200.00
RE DISCCART   -341.53   -863.47   1600.00    2200.00
RE DISCCART   -133.80   -612.84   1600.00    2200.00
RE DISCCART    242.75   -647.07   1600.00    2200.00
RE DISCCART    448.16   -311.09   1600.00    2200.00
RE DISCCART    592.43     59.94   1600.00    2200.00
RE DISCCART    918.60    238.86   1600.00    2200.00
RE DISCCART   1228.23      4.15   1600.00    2200.00
RE DISCCART   1088.95   -350.46   1600.00    2200.00
RE DISCCART    885.35   -698.68   1600.00    2200.00
RE DISCCART   -505.50  -2155.00   1700.00    2200.00
RE DISCCART   -480.41  -1760.47   1700.00    2200.00
RE DISCCART   -465.41  -1358.34   1700.00    2200.00
RE DISCCART   -310.06   -987.10   1700.00    2200.00
RE DISCCART   -138.32   -654.32   1700.00    2200.00
RE DISCCART    231.42   -710.58   1700.00    2200.00
RE DISCCART    469.14   -408.24   1700.00    2200.00
RE DISCCART    618.92    -32.23   1700.00    2200.00
RE DISCCART    944.57    168.79   1700.00    2200.00
RE DISCCART   1164.28   -117.76   1700.00    2200.00
RE DISCCART    962.35   -467.47   1700.00    2200.00
RE DISCCART    783.63   -831.20   1700.00    2200.00
RE DISCCART   -357.70  -2305.00   1800.00    2200.00
```

** Piedmont Hill
** High Stack Height: 150 meters
** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
** Far from Hill: 10 km away
** Meteorology from 100-m Tower and Sodar

RE DISCCART	-437.57	-1945.98	1800.00	2200.00
RE DISCCART	-369.41	-1566.25	1800.00	2200.00
RE DISCCART	-285.45	-1172.66	1800.00	2200.00
RE DISCCART	-166.77	-788.53	1800.00	2200.00
RE DISCCART	192.72	-801.51	1800.00	2200.00
RE DISCCART	486.38	-562.30	1800.00	2200.00
RE DISCCART	638.29	-189.10	1800.00	2200.00
RE DISCCART	945.65	31.54	1800.00	2200.00
RE DISCCART	1040.60	-246.59	1800.00	2200.00
RE DISCCART	845.76	-601.19	1800.00	2200.00
RE DISCCART	700.78	-978.55	1800.00	2200.00
RE DISCCART	-312.10	-2275.00	1900.00	2200.00
RE DISCCART	-352.85	-1926.16	1900.00	2200.00
RE DISCCART	-284.39	-1572.42	1900.00	2200.00
RE DISCCART	-219.41	-1204.49	1900.00	2200.00
RE DISCCART	-103.65	-845.19	1900.00	2200.00
RE DISCCART	231.54	-848.17	1900.00	2200.00
RE DISCCART	526.84	-634.35	1900.00	2200.00
RE DISCCART	675.48	-292.95	1900.00	2200.00
RE DISCCART	957.97	-77.44	1900.00	2200.00
RE DISCCART	856.22	-432.11	1900.00	2200.00
RE DISCCART	728.44	-787.98	1900.00	2200.00
RE DISCCART	646.54	-1155.69	1900.00	2200.00
RE DISCCART	-211.00	-2248.00	2000.00	2200.00
RE DISCCART	-208.98	-2019.81	2000.00	2200.00
RE DISCCART	-103.15	-1812.17	2000.00	2200.00
RE DISCCART	-133.27	-1588.07	2000.00	2200.00
RE DISCCART	-159.02	-1357.53	2000.00	2200.00
RE DISCCART	-71.30	-1142.46	2000.00	2200.00
RE DISCCART	67.68	-957.10	2000.00	2200.00
RE DISCCART	296.79	-912.52	2000.00	2200.00
RE DISCCART	524.56	-859.69	2000.00	2200.00
RE DISCCART	573.38	-1049.63	2000.00	2200.00
RE DISCCART	607.64	-1272.62	2000.00	2200.00
RE DISCCART	677.99	-1493.23	2000.00	2200.00
RE DISCCART	99.85	-2515.00	2100.00	2200.00
RE DISCCART	52.53	-2279.43	2100.00	2200.00
RE DISCCART	34.82	-2043.20	2100.00	2200.00
RE DISCCART	93.40	-1816.61	2100.00	2200.00
RE DISCCART	-9.02	-1599.99	2100.00	2200.00
RE DISCCART	2.67	-1394.18	2100.00	2200.00
RE DISCCART	127.68	-1190.55	2100.00	2200.00
RE DISCCART	276.83	-1010.06	2100.00	2200.00
RE DISCCART	443.05	-1102.06	2100.00	2200.00
RE DISCCART	421.80	-1337.79	2100.00	2200.00
RE DISCCART	613.92	-1451.98	2100.00	2200.00
RE DISCCART	643.13	-1689.91	2100.00	2200.00
RE DISCCART	348.70	-2665.00	2200.00	2200.00
RE DISCCART	323.75	-2501.71	2200.00	2200.00
RE DISCCART	375.69	-2350.23	2200.00	2200.00
RE DISCCART	308.07	-2194.93	2200.00	2200.00
RE DISCCART	340.42	-2038.55	2200.00	2200.00
RE DISCCART	409.93	-1883.47	2200.00	2200.00
RE DISCCART	387.04	-1722.33	2200.00	2200.00
RE DISCCART	296.38	-1584.62	2200.00	2200.00
RE DISCCART	440.59	-1521.57	2200.00	2200.00
RE DISCCART	552.40	-1613.29	2200.00	2200.00
RE DISCCART	606.70	-1773.86	2200.00	2200.00
RE DISCCART	666.27	-1932.25	2200.00	2200.00

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                    ** Piedmont Hill
              ** High Stack Height: 150 meters
     ** Low Buoyancy Case: 2-m diameter, 10 m/s Exit Vel, 400 K
              ** Far from Hill: 10 km away
          ** Meteorology from 100-m Tower and Sodar

RE FINISHED

ME STARTING
   SURFFILE  SURFACE  FREE
   PROFFILE  PROFILE  FREE
   SURFDATA  99999  1994  Tower/Sodar
   UAIRDATA  99999  1994  Tower/Sodar
   SITEDATA  00000  1994  Tower/Sodar
   PROFBASE 0
ME FINISHED

OU STARTING
   RECTABLE  ALLAVE  FIRST-SECOND
OU FINISHED
```

APPENDIX D

FLAT AND SIMPLE TERRAIN MODELING RESULTS --

LISTING OF REGULATORY DESIGN CONCENTRATIONS

Flat and Simple Terrain Modeling Results -- Listing of Regulatory Design Concentrations (ug/m3)

[R05NBO]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	641512.5	1477255	|	638394.438	1477254.875
3 Hour	426806.188	940304.8	|	305429.938	662622.75
24 Hour	90423.156	167826.9	|	80059.523	135505.828
Annual	5963.393	15366.99	|		
[R05NBP]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	790999.375	2215382	|	639933.875	1477254.875
3 Hour	504185.813	829372.6	|	287486.375	672883.063
24 Hour	116270.555	334984.8	|	70961.703	150279.984
Annual	4635.645	9266.431	|		
[R10NBO]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	383587.656	867862.1	|	382183.156	867862.063
3 Hour	267486.75	552378.3	|	224770.422	391787.094
24 Hour	70672.492	101781.8	|	56722.469	87916.758
Annual	5902.933	11472.43	|		
[R10NBP]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	455737.531	1283044	|	382878.594	867862.063
3 Hour	343985.781	487137.6	|	214798.75	396582.5
24 Hour	81484.945	204387.5	|	50098.57	91165.875
Annual	4330.417	7043.903	|		
[R20NBO]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	38345.699	75184.67	|	27778.221	50406.961
3 Hour	22241.115	30274.28	|	17281.816	19750.986
24 Hour	8609.457	8004.893	|	7806.718	5218.02
Annual	1978.963	869.229	|		
[R20NBP]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	39799.941	75951.45	|	34646.813	48894.824
3 Hour	24160.863	32424.83	|	18299.582	21919.477
24 Hour	9335.576	7736.869	|	7733.726	6169.623
Annual	1339.179	695.227	|		
[R35MFO]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	1524.225	1394.014	|	1386.511	1256.623
3 Hour	1058.601	1090.533	|	907.397	973.259
24 Hour	534.27	329.07	|	520.654	302.235
Annual	81.114	40.46	|		
[R35MFP]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	1694.165	1394.014	|	1511.061	1266.728
3 Hour	1148.959	951.792	|	853.962	722.924
24 Hour	409.321	339.34	|	300.731	232.213
Annual	51.015	27.808	|		

The scenario code is as follows: the first letter indicates the urban or rural option; the next set of numbers represent the stack height in meters; VOL=non-buoyant volume source, ARE=non-buoyant area source; the next set of letters describe the buoyancy (NB=no buoyancy, M=[moderately]buoyant, B=very buoyant, for 100, 200 meter stacks=very buoyant), the next letter indicates the terrain (F=flat,T=simple), the last letter identifies the location of the meteorological data (O=Oklahoma City, OK, P=Pittsburgh,PA)

Flat and Simple Terrain Modeling Results -- Listing of Regulatory Design Concentrations (ug/m3)

[R35BFO]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	421.422	265.131	|	413.844	255.05
3 Hour	392.512	183.23	|	376.038	180.679
24 Hour	202.805	80.045	|	186.945	68.708
Annual	25.287	8.103	|		
[R35BFP]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	413.627	262.583	|	400.813	260.8
3 Hour	391.487	195.147	|	336.051	139.389
24 Hour	169.974	64.135	|	155.272	51.838
Annual	18.509	5.464	|		
[R100FO]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	56.418	61.503	|	48.55	53.908
3 Hour	44.05	38.195	|	39.431	27.909
24 Hour	13.215	6.271	|	12.993	5.537
Annual	1.704	0.632	|		
[R100FP]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	49.324	52.961	|	46.259	50.025
3 Hour	40.557	27.506	|	34.82	18.259
24 Hour	14.013	7.965	|	10.96	4.17
Annual	1.301	0.4	|		
[R200FO]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	35.644	34.407	|	20.517	20.742
3 Hour	16.188	13.353	|	10.884	10.425
24 Hour	3.668	2.594	|	3.397	1.907
Annual	0.468	0.148	|		
[R200FP]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	29.073	34.789	|	18.251	31.305
3 Hour	11.768	11.596	|	9.725	10.98
24 Hour	3.882	3.174	|	3.127	1.714
Annual	0.319	0.082	|		
[R35BTO]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	318.221	286.319	|	316.538	252.17
3 Hour	305.594	160.619	|	299.89	147.087
24 Hour	184.92	58.677	|	173.045	50.738
Annual	21.946	6.466	|		
[R35BTP]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	310.211	298.393	|	307.683	283.529
3 Hour	285.027	208.694	|	282.443	166.753
24 Hour	146.793	68.577	|	128.066	57.498
Annual	14.175	6.193	|		
[R200TO]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	34.545	34.407	|	20.256	22.26
3 Hour	15.901	17.229	|	10.786	14.458
24 Hour	3.727	5.957	|	3.538	3.802
Annual	0.478	0.514	|		

Flat and Simple Terrain Modeling Results -- Listing of Regulatory Design Concentrations (ug/m3)

[R200TP]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	28.872	34.789	|	18.061	31.304
3 Hour	11.411	15.118	|	10.058	12.993
24 Hour	4.069	4.775	|	3.251	4.005
Annual	0.369	0.344	|		
[R10VOLFO]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	58216.734	64067.26	|	57588.129	46110.68
3 Hour	42419.371	36748.28	|	40093.781	30941.094
24 Hour	15323.012	13419.61	|	12669.787	11018.088
Annual	2643.76	2495.823	|		
[R10VOLFP]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	72433.18	80443.9	|	61478.301	80043.75
3 Hour	52938.102	41500.9	|	39982.84	34219.02
24 Hour	18388.494	17190.53	|	12203.159	11907.336
Annual	1698.436	1655.717	|		
[R35VOLFO]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	9204.215	13468.27	|	8634.53	8979.14
3 Hour	5487.158	6059.586	|	4466.404	4794.595
24 Hour	1798.722	2021.609	|	1536.333	1728.312
Annual	381.469	412.311	|		
[R35VOLFP]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	13186.087	14574.06	|	10236.682	10244.131
3 Hour	6235.917	6079.271	|	4874.92	5009.671
24 Hour	1763.822	2177.855	|	1747.462	1806.692
Annual	273.352	298.815	|		
[RAREFO]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	28020.381	13735.56	|	18981.563	13735.563
3 Hour	18170.254	13172.55	|	14624.335	12176.079
24 Hour	7776.939	6654.456	|	5871.392	5903.537
Annual	1662.596	2572.51	|		
[RAREFP]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	30893.193	20469.1	|	30048.4	19833.777
3 Hour	19615.559	15323.86	|	16649.027	12570.367
24 Hour	8210.229	7766.057	|	7723.543	7352.994
Annual	2177.042	3044.322	|		
[U05NBO]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	349737.094	166843.9	|	346638.313	166843.891
3 Hour	240031.156	128403.7	|	211101.484	99092.898
24 Hour	63886.02	30375.93	|	50631.641	27853.563
Annual	5089.685	5129.064	|		
[U05NBP]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	685198.625	249766.2	|	525950.563	166843.891
3 Hour	320320.563	138194.3	|	203578.375	110570.969
24 Hour	82741.945	53847.87	|	43431.93	28908.451
Annual	3822.914	3033.091	|		

Flat and Simple Terrain Modeling Results -- Listing of Regulatory Design Concentrations (ug/m3)

[U10NBO]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	179088.516	158840.5	|	178719.609	158840.469
3 Hour	129686.461	122283.4	|	124853.773	94426.375
24 Hour	43389.961	28991.26	|	30945.68	26608.963
Annual	4651.018	4942.427	|		
[U10NBP]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	298000.531	237471.1	|	269432.813	158840.469
3 Hour	173507.625	131539.6	|	119611.547	105293.836
24 Hour	48711.918	51354.44	|	37274.063	27742.863
Annual	3370.117	2923.264	|		
[U20NBO]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	30195.426	57890.09	|	21445.746	50776.68
3 Hour	18929.273	39065.86	|	13598.144	31451.604
24 Hour	7534.939	11451.02	|	7047.805	9885.435
Annual	2146.922	2119.165	|		
[U20NBP]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	27610.469	75675.85	|	26579.65	55157.301
3 Hour	18571.771	41894.65	|	15540.822	33608.371
24 Hour	8094.63	17304.62	|	7428.738	10885.992
Annual	1394.292	1397.956	|		
[U35BFO]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	479.37	698.747	|	447.146	593.099
3 Hour	417.638	451.305	|	405.063	364.753
24 Hour	292.757	284.926	|	270.714	271.591
Annual	36.549	37.482	|		
[U35BFP]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	450.038	571.776	|	438.558	442.906
3 Hour	407.612	361.45	|	380.134	347.348
24 Hour	227.199	217.135	|	205.481	192.701
Annual	26.372	25.676	|		
[U35MFO]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	1536.192	2221.66	|	1282.819	1858.567
3 Hour	1012.043	1462.363	|	957.839	1403.418
24 Hour	531.359	893.581	|	521.202	808.996
Annual	112.547	141.51	|		
[U35MFP]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	1636.778	2358.429	|	1523.413	1858.567
3 Hour	1058.929	1644.183	|	846.096	1401.004
24 Hour	434.702	933.122	|	360.742	756.107
Annual	63.367	103.658	|		
[U100FO]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	53.737	83.44	|	52.129	73.542
3 Hour	49.156	53.916	|	46.583	48.862
24 Hour	18.125	30.15	|	15.485	29.841
Annual	2.24	4.082	|		

Flat and Simple Terrain Modeling Results -- Listing of Regulatory Design Concentrations (ug/m3)

[U100FP]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	53.227	80.153	|	50.687	72.135
3 Hour	45.993	56.648	|	40.704	49.627
24 Hour	17.13	23.29	|	13.539	20.216
Annual	1.686	2.602	|		
[U200FO]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	29.825	31.343	|	18.256	29.724
3 Hour	14.002	21.518	|	11.11	19.783
24 Hour	4.23	11.065	|	4.202	9.36
Annual	0.625	1.276	|		
[U200FP]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	24.958	31.041	|	15.551	27.261
3 Hour	11.151	20.278	|	10.858	19.414
24 Hour	4.415	8.419	|	3.49	6.496
Annual	0.464	0.88	|		
[U35BTO]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	267.125	480.753	|	263.462	436.44
3 Hour	257.294	343.307	|	252.48	254.127
24 Hour	164.645	127.106	|	162.426	110.706
Annual	27.751	18.255	|		
[U35BTP]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	264.912	631.366	|	256.697	492.156
3 Hour	247.186	307.062	|	246.245	278.434
24 Hour	159.604	151.637	|	128.109	133.317
Annual	16.936	22.235	|		
[U200TO]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	28.568	74.11	|	20.304	63.403
3 Hour	13.376	51.429	|	11.193	41.844
24 Hour	4.369	13.322	|	4.276	11.598
Annual	0.637	1.855	|		
[U200TP]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	24.474	75.761	|	20.947	74.947
3 Hour	12.699	46.107	|	11.569	43.78
24 Hour	4.492	18.84	|	3.555	16.305
Annual	0.509	1.673	|		
[U10VOLFO]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	31040.219	27224.75	|	30814.16	27224.75
3 Hour	24559.211	22245.89	|	23858.006	20070.086
24 Hour	11102.367	8806.903	|	8750.225	7551.796
Annual	2340.866	1775.303	|		
[U10VOLFP]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	43624.141	40764.4	|	40444.527	36306.938
3 Hour	29788.068	25953.01	|	23563.035	22192.006
24 Hour	11488.247	11015.76	|	8635.544	7792.398
Annual	1535.059	1106.064	|		

Flat and Simple Terrain Modeling Results -- Listing of Regulatory Design Concentrations (ug/m3)

[UVOLFO]	AERMOD-HI	ISC		AERMOD-H2H	ISC
1 Hour	8284.659	10785.66	|	7748.117	8430.134
3 Hour	4986.399	5599.988	|	4072.211	5197.693
24 Hour	1624.333	2735.922	|	1464.168	2149.363
Annual	387.781	594.151	|		
[UVOLFP]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	12016.902	10785.66	|	9421.423	9608.633
3 Hour	5810.947	6186.922	|	4580.654	5279.594
24 Hour	1571.719	2839.217	|	1459.232	2302.406
Annual	275.405	404.804	|		
[UAREFO]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	20856.262	4902.429	|	14001.1	4902.429
3 Hour	13501.006	4787.335	|	10607.275	4411.018
24 Hour	5747.044	2650.717	|	4149.254	2275.924
Annual	1260.329	1095.013	|		
[UAREFP]	AERMOD-HI	ISC	|	AERMOD-H2H	ISC
1 Hour	23116.906	7321.925	|	22689.154	7202.287
3 Hour	14508.641	5631.366	|	12513.621	4690.512
24 Hour	5689.807	3005.476	|	5633.224	2882.408
Annual	1637.721	1287.381	|		

APPENDIX E

COMPLEX TERRAIN MODELING RESULTS:
LISTING OF REGULATORY DESIGN CONCENTRATIONS (UG/M3)

Listing Of All Complex Terrain Modeling Results (Concentration values in ug/m3)					
PHLLC					
	AERMOD	ISC	CTDM+	AER/ISC	AER/CTDM+
1 Hour H1H	39.773	88.349	51.65	0.45	0.77
1 Hour H2H	37.845	87.987	50.19	0.43	0.754
3 Hour H1H	25.919	78.591	29.74	0.33	0.872
3 Hour H2H	22.494	73.306	28.56	0.307	0.788
24 Hour H1H	5.727	24.103	11.34	0.238	0.505
24 Hour H2H	4.02	18.047	8.06	0.223	0.499
Annual	0.565	2.703	1.224	0.209	0.461
MCLLC					
	AERMOD	ISC	CTDM+	AER/ISC	AER/CTDM+
1 Hour H1H	30.577	51.612	24.98	0.592	1.224
1 Hour H2H	22.016	50.919	21.65	0.432	1.017
3 Hour H1H	11.491	48.584	15.8	0.237	0.727
3 Hour H2H	10.523	41.564	9.087	0.253	1.158
24 Hour H1H	2.294	12.846	3.989	0.179	0.575
24 Hour H2H	1.801	10.534	2.907	0.171	0.62
Annual	0.225	1.348	0.446	0.167	0.504
MALLC					
	AERMOD	ISC	CTDM+	AER/ISC	AER/CTDM+
1 Hour H1H	12.466	43.626	27.37	0.286	0.455
1 Hour H2H	11.842	43.351	19.28	0.273	0.614
3 Hour H1H	4.634	37.516	9.122	0.124	0.508
3 Hour H2H	3.947	34.43	8.228	0.115	0.48
24 Hour H1H	1.071	9.473	1.343	0.113	0.798
24 Hour H2H	0.951	8.015	1.278	0.119	0.744
Annual	0.084	0.564	0.148	0.149	0.565
CCLLC					
	AERMOD	ISC	CTDM+	AER/ISC	AER/CTDM+
1 Hour H1H	14.381	48.416	11.64	0.297	1.236
1 Hour H2H	11.621	48.416	9.562	0.24	1.215
3 Hour H1H	8.216	42.68	4.735	0.193	1.735
3 Hour H2H	5.702	32.291	3.361	0.177	1.697
24 Hour H1H	1.701	9.707	0.82	0.175	2.074
24 Hour H2H	1.116	7.256	0.726	0.154	1.537
Annual	0.083	0.48	0.083	0.173	0.996

The code for each scenario evaluated is as follows: The first 2 letters refer to the name of the hill: PH = Piedmont, MC = Montour Crosswind, MA = Montour Alongwind, CC = Cinder Cone Butte. The 3rd letter refers to the stack height: L = 30 meters, H = 150m. The fourth letter refers to the buoyancy: L = low, H = high. The fifth letter stands for the distance between the source and the hill: C = close or 1 kilometer, F = far or 10 km.

Listing Of All Complex Terrain Modeling Results (Concentration values in ug/m3)					
PHLLF					
	AERMOD	ISC	CTDM+	AER/ISC	AER/CTDM+
1 Hour H1H	3.504	8.293	2.804	0.423	1.25
1 Hour H2H	3.262	7.971	2.334	0.409	1.398
3 Hour H1H	1.592	4.908	1.393	0.324	1.143
3 Hour H2H	1.157	3.841	1.235	0.301	0.937
24 Hour H1H	0.248	1.122	0.246	0.221	1.009
24 Hour H2H	0.21	0.739	0.198	0.284	1.062
Annual	0.018	0.067	0.015	0.268	1.167
MCLLF					
	AERMOD	ISC	CTDM+	AER/ISC	AER/CTDM+
1 Hour H1H	4.242	8.024	3.086	0.529	1.375
1 Hour H2H	3.116	7.649	2.392	0.407	1.303
3 Hour H1H	1.495	5.108	1.828	0.293	0.818
3 Hour H2H	1.128	4.486	1.264	0.251	0.892
24 Hour H1H	0.358	1.133	0.363	0.316	0.986
24 Hour H2H	0.32	0.979	0.355	0.327	0.902
Annual	0.036	0.109	0.041	0.328	0.87
MALLF					
	AERMOD	ISC	CTDM+	AER/ISC	AER/CTDM+
1 Hour H1H	1.484	7.78	1.988	0.191	0.747
1 Hour H2H	1.092	7.662	1.886	0.142	0.579
3 Hour H1H	0.682	4.03	0.662	0.169	1.03
3 Hour H2H	0.581	3.327	0.629	0.174	0.923
24 Hour H1H	0.166	0.842	0.103	0.197	1.608
24 Hour H2H	0.111	0.57	0.084	0.194	1.317
Annual	0.007	0.038	0.009	0.177	0.726
CCLLF					
	AERMOD	ISC	CTDM+	AER/ISC	AER/CTDM+
1 Hour H1H	1.751	8.073	1.429	0.217	1.225
1 Hour H2H	1.489	7.663	1.163	0.194	1.28
3 Hour H1H	1.011	4.604	0.677	0.22	1.493
3 Hour H2H	0.646	3.016	0.388	0.214	1.664
24 Hour H1H	0.132	0.805	0.102	0.164	1.297
24 Hour H2H	0.084	0.762	0.088	0.11	0.955
Annual	0.007	0.037	0.008	0.179	0.832

The code for each scenario evaluated is as follows: The first 2 letters refer to the name of the hill: PH = Piedmont, MC = Montour Crosswind, MA = Montour Alongwind, CC = Cinder Cone Butte. The 3rd letter refers to the stack height: L = 30 meters, H = 150m. The fourth letter refers to the buoyancy: L = low, H = high. The fifth letter stands for the distance between the source and the hill: C = close or 1 kilometer, F = far or 10 km.

Listing Of All Complex Terrain Modeling Results (Concentration values in ug/m3)					
PHLHC					
	AERMOD	ISC	CTDM+	AER/ISC	AER/CTDM+
1 Hour H1H	5.625	18.709	8.617	0.301	0.653
1 Hour H2H	4.994	18.672	7.6	0.267	0.657
3 Hour H1H	3.418	17.274	4.413	0.198	0.774
3 Hour H2H	2.797	16.654	3.761	0.168	0.744
24 Hour H1H	0.679	5.399	0.976	0.126	0.695
24 Hour H2H	0.63	4.246	0.796	0.148	0.792
Annual	0.063	0.581	0.067	0.109	0.949
MCLHC					
	AERMOD	ISC	CTDM+	AER/ISC	AER/CTDM+
1 Hour H1H	2.952	9.41	6.44	0.314	0.458
1 Hour H2H	2.613	9.385	4.55	0.278	0.574
3 Hour H1H	2.063	9.208	2.147	0.224	0.961
3 Hour H2H	1.804	9.164	1.658	0.197	1.088
24 Hour H1H	0.366	3.195	0.419	0.114	0.873
24 Hour H2H	0.345	2.775	0.369	0.124	0.935
Annual	0.023	0.249	0.032	0.092	0.722
MALHC					
	AERMOD	ISC	CTDM+	AER/ISC	AER/CTDM+
1 Hour H1H	1.3	5.684	3.763	0.229	0.345
1 Hour H2H	1.099	5.684	3.732	0.193	0.294
3 Hour H1H	0.535	5.534	2.297	0.097	0.233
3 Hour H2H	0.509	4.72	1.304	0.108	0.39
24 Hour H1H	0.099	1.284	0.315	0.077	0.315
24 Hour H2H	0.078	0.836	0.276	0.094	0.284
Annual	0.007	0.052	0.018	0.135	0.387
CCLHC					
	AERMOD	ISC	CTDM+	AER/ISC	AER/CTDM+
1 Hour H1H	0.469	0.878	1.48	0.534	0.317
1 Hour H2H	0.332	0.869	1.25	0.381	0.265
3 Hour H1H	0.157	0.788	0.874	0.199	0.18
3 Hour H2H	0.111	0.779	0.598	0.142	0.186
24 Hour H1H	0.031	0.304	0.151	0.102	0.205
24 Hour H2H	0.02	0.143	0.077	0.141	0.262
Annual	0.001	0.01	0.003	0.125	0.373

The code for each scenario evaluated is as follows: The first 2 letters refer to the name of the hill: PH = Piedmont, MC = Montour Crosswind, MA = Montour Alongwind, CC = Cinder Cone Butte. The 3rd letter refers to the stack height: L = 30 meters, H = 150m. The fourth letter refers to the buoyancy: L = low, H = high. The fifth letter stands for the distance between the source and the hill: C = close or 1 kilometer, F = far or 10 km.

Listing Of All Complex Terrain Modeling Results (Concentration values in ug/m3)					
PHLHF					
	AERMOD	ISC	CTDM+	AER/ISC	AER/CTDM+
1 Hour H1H	0.664	2.309	1.806	0.288	0.368
1 Hour H2H	0.563	2.309	1.581	0.244	0.356
3 Hour H1H	0.32	2.037	0.629	0.157	0.509
3 Hour H2H	0.215	1.867	0.527	0.115	0.409
24 Hour H1H	0.066	0.445	0.133	0.148	0.497
24 Hour H2H	0.042	0.36	0.082	0.118	0.516
Annual	0.003	0.026	0.004	0.099	0.564
MCLHF					
	AERMOD	ISC	CTDM+	AER/ISC	AER/CTDM+
1 Hour H1H	0.461	1.547	1.384	0.298	0.333
1 Hour H2H	0.383	1.547	0.872	0.248	0.439
3 Hour H1H	0.27	1.477	0.461	0.183	0.586
3 Hour H2H	0.178	1.164	0.372	0.153	0.478
24 Hour H1H	0.047	0.408	0.064	0.115	0.736
24 Hour H2H	0.033	0.284	0.053	0.115	0.615
Annual	0.004	0.028	0.005	0.128	0.685
MALHF					
	AERMOD	ISC	CTDM+	AER/ISC	AER/CTDM+
1 Hour H1H	0.303	1.381	0.988	0.22	0.307
1 Hour H2H	0.257	1.381	0.694	0.186	0.371
3 Hour H1H	0.125	1.321	0.339	0.095	0.369
3 Hour H2H	0.101	0.908	0.296	0.111	0.342
24 Hour H1H	0.026	0.307	0.053	0.085	0.493
24 Hour H2H	0.023	0.207	0.052	0.113	0.451
Annual	0.003	0.012	0.004	0.208	0.62
CCLHF					
	AERMOD	ISC	CTDM+	AER/ISC	AER/CTDM+
1 Hour H1H	0.246	0.27	0.608	0.913	0.405
1 Hour H2H	0.192	0.262	0.408	0.732	0.471
3 Hour H1H	0.093	0.219	0.231	0.425	0.403
3 Hour H2H	0.084	0.217	0.195	0.388	0.431
24 Hour H1H	0.016	0.088	0.031	0.187	0.531
24 Hour H2H	0.012	0.044	0.025	0.281	0.493
Annual	0.001	0.003	0.001	0.229	0.682

The code for each scenario evaluated is as follows: The first 2 letters refer to the name of the hill: PH = Piedmont, MC = Montour Crosswind, MA = Montour Alongwind, CC = Cinder Cone Butte. The 3rd letter refers to the stack height: L = 30 meters, H = 150m. The fourth letter refers to the buoyancy: L = low, H = high. The fifth letter stands for the distance between the source and the hill: C = close or 1 kilometer, F = far or 10 km.

Listing Of All Complex Terrain Modeling Results (Concentration values in ug/m3)					
PHHLC					
	AERMOD	ISC	CTDM+	AER/ISC	AER/CTDM+
1 Hour H1H	17.253	49.86	19.19	0.346	0.899
1 Hour H2H	13.117	49.715	16.53	0.264	0.794
3 Hour H1H	8.895	28.962	9.229	0.307	0.964
3 Hour H2H	7.626	26.97	7.371	0.283	1.035
24 Hour H1H	2.848	9.578	3.035	0.297	0.938
24 Hour H2H	2.243	8.275	2.08	0.271	1.078
Annual	0.25	1.022	0.307	0.244	0.814
MCHLC					
	AERMOD	ISC	CTDM+	AER/ISC	AER/CTDM+
1 Hour H1H	11.966	28.886	13.88	0.414	0.862
1 Hour H2H	10.469	28.812	4.908	0.363	2.133
3 Hour H1H	6.143	19.196	4.627	0.32	1.328
3 Hour H2H	5.379	16.396	3.048	0.328	1.765
24 Hour H1H	1.419	4.287	0.879	0.331	1.614
24 Hour H2H	1.208	3.845	0.809	0.314	1.493
Annual	0.096	0.579	0.105	0.166	0.915
MAHLC					
	AERMOD	ISC	CTDM+	AER/ISC	AER/CTDM+
1 Hour H1H	6.614	15.289	9.935	0.433	0.666
1 Hour H2H	4.252	15.289	5.439	0.278	0.782
3 Hour H1H	2.935	8.119	3.961	0.361	0.741
3 Hour H2H	1.902	6.722	2.173	0.283	0.875
24 Hour H1H	0.503	2.004	0.495	0.251	1.017
24 Hour H2H	0.285	1.815	0.401	0.157	0.71
Annual	0.024	0.128	0.034	0.185	0.698
PHHLF					
	AERMOD	ISC	CTDM+	AER/ISC	AER/CTDM+
1 Hour H1H	2.312	7.064	2.898	0.327	0.798
1 Hour H2H	2.079	6.271	2.546	0.331	0.816
3 Hour H1H	0.86	2.727	1.013	0.316	0.849
3 Hour H2H	0.693	2.338	0.889	0.296	0.779
24 Hour H1H	0.129	0.64	0.167	0.202	0.775
24 Hour H2H	0.118	0.44	0.131	0.268	0.901
Annual	0.006	0.037	0.008	0.16	0.741

The code for each scenario evaluated is as follows: The first 2 letters refer to the name of the hill: PH = Piedmont, MC = Montour Crosswind, MA = Montour Alongwind, CC = Cinder Cone Butte. The 3rd letter refers to the stack height: L = 30 meters, H = 150m. The fourth letter refers to the buoyancy: L = low, H = high. The fifth letter stands for the distance between the source and the hill: C = close or 1 kilometer, F = far or 10 km.

Listing Of All Complex Terrain Modeling Results (Concentration values in ug/m3)					
MCHLF					
	AERMOD	ISC	CTDM+	AER/ISC	AER/CTDM+
1 Hour H1H	1.76	6.74	2.079	0.261	0.847
1 Hour H2H	1.73	6.254	1.096	0.277	1.579
3 Hour H1H	0.702	4.232	0.693	0.166	1.013
3 Hour H2H	0.577	2.611	0.415	0.221	1.391
24 Hour H1H	0.113	0.61	0.087	0.186	1.303
24 Hour H2H	0.072	0.566	0.064	0.128	1.131
Annual	0.007	0.058	0.007	0.121	0.997
MAHLF					
	AERMOD	ISC	CTDM+	AER/ISC	AER/CTDM+
1 Hour H1H	1.399	6.509	1.732	0.215	0.808
1 Hour H2H	0.884	6.371	1.072	0.139	0.825
3 Hour H1H	0.466	2.17	0.696	0.215	0.67
3 Hour H2H	0.406	2.16	0.441	0.188	0.922
24 Hour H1H	0.072	0.43	0.087	0.168	0.83
24 Hour H2H	0.058	0.423	0.081	0.138	0.722
Annual	0.005	0.022	0.007	0.249	0.769
PHHHC					
	AERMOD	ISC	CTDM+	AER/ISC	AER/CTDM+
1 Hour H1H	1.606	8.606	6.321	0.187	0.254
1 Hour H2H	1.189	8.578	4.145	0.139	0.287
3 Hour H1H	0.639	6.329	2.221	0.101	0.288
3 Hour H2H	0.471	6.16	1.771	0.077	0.266
24 Hour H1H	0.371	2.065	0.407	0.18	0.912
24 Hour H2H	0.153	1.635	0.352	0.094	0.436
Annual	0.02	0.205	0.016	0.099	1.24
MCHHC					
	AERMOD	ISC	CTDM+	AER/ISC	AER/CTDM+
1 Hour H1H	0.717	1.029	1.698	0.697	0.422
1 Hour H2H	0.316	1.026	1.17	0.308	0.27
3 Hour H1H	0.24	0.945	0.743	0.254	0.323
3 Hour H2H	0.143	0.935	0.553	0.153	0.258
24 Hour H1H	0.066	0.389	0.11	0.17	0.6
24 Hour H2H	0.042	0.371	0.091	0.113	0.46
Annual	0.004	0.022	0.008	0.178	0.491

The code for each scenario evaluated is as follows: The first 2 letters refer to the name of the hill: PH = Piedmont, MC = Montour Crosswind, MA = Montour Alongwind, CC = Cinder Cone Butte. The 3rd letter refers to the stack height: L = 30 meters, H = 150m. The fourth letter refers to the buoyancy: L = low, H = high. The fifth letter stands for the distance between the source and the hill: C = close or 1 kilometer, F = far or 10 km.

Listing Of All Complex Terrain Modeling Results (Concentration values in ug/m3)					
MAHHC					
	AERMOD	ISC	CTDM+	AER/ISC	AER/CTDM+
1 Hour H1H	0.252	0.659	1.237	0.382	0.203
1 Hour H2H	0.219	0.643	0.879	0.341	0.249
3 Hour H1H	0.124	0.614	0.429	0.202	0.289
3 Hour H2H	0.093	0.525	0.355	0.177	0.262
24 Hour H1H	0.035	0.124	0.12	0.282	0.292
24 Hour H2H	0.03	0.077	0.082	0.393	0.369
Annual	0.002	0.006	0.005	0.342	0.41
PHHHF					
	AERMOD	ISC	CTDM+	AER/ISC	AER/CTDM+
1 Hour H1H	0.167	1.625	1.339	0.103	0.125
1 Hour H2H	0.138	1.625	1.12	0.085	0.123
3 Hour H1H	0.088	1.083	0.645	0.081	0.137
3 Hour H2H	0.081	0.964	0.374	0.084	0.217
24 Hour H1H	0.015	0.204	0.093	0.072	0.159
24 Hour H2H	0.012	0.16	0.082	0.076	0.147
Annual	0.001	0.011	0.002	0.092	0.49
MCHHF					
	AERMOD	ISC	CTDM+	AER/ISC	AER/CTDM+
1 Hour H1H	0.174	0.274	0.288	0.635	0.604
1 Hour H2H	0.17	0.272	0.197	0.626	0.864
3 Hour H1H	0.082	0.235	0.123	0.348	0.664
3 Hour H2H	0.074	0.233	0.084	0.318	0.882
24 Hour H1H	0.02	0.095	0.018	0.209	1.102
24 Hour H2H	0.013	0.053	0.018	0.24	0.713
Annual	0.002	0.007	0.002	0.235	0.765
MAHHF					
	AERMOD	ISC	CTDM+	AER/ISC	AER/CTDM+
1 Hour H1H	0.154	0.276	0.168	0.557	0.914
1 Hour H2H	0.128	0.266	0.132	0.482	0.973
3 Hour H1H	0.083	0.217	0.079	0.384	1.053
3 Hour H2H	0.054	0.193	0.063	0.28	0.857
24 Hour H1H	0.014	0.053	0.025	0.265	0.561
24 Hour H2H	0.012	0.034	0.018	0.353	0.662
Annual	0.001	0.003	0.002	0.504	0.761

The code for each scenario evaluated is as follows: The first 2 letters refer to the name of the hill: PH = Piedmont, MC = Montour Crosswind, MA = Montour Alongwind, CC = Cinder Cone Butte. The 3rd letter refers to the stack height: L = 30 meters, H = 150m. The fourth letter refers to the buoyancy: L = low, H = high. The fifth letter stands for the distance between the source and the hill: C = close or 1 kilometer, F = far or 10 km.

APPENDIX F

LISTING OF AERMOD/ISCST3 INPUT FILES USED IN THE TIMING ANALYSIS

AERMOD INPUT FILE FOR POINT SOURCE TIMING ANALYSIS

```
CO STARTING
CO TITLEONE RURAL - 100 METER STACK - FLAT TERRAIN
CO TITLETWO
CO MODELOPT  CONC   MSGPRO
CO POLLUTID SO2
CO AVERTIME  PERIOD   1  3 24
CO DCAYCOEF    .000000

CO RUNORNOT RUN
CO ERRORFIL ERRORS.OUT
CO FINISHED


SO STARTING

** Source Location Cards:
**         SRCID SRCTYP       XS           YS           ZS

SO LOCATION     5 POINT         .0000        .0000        .0000

** Source Parameter Cards:
** POINT:   SRCID       QS           HS        TS         VS        DS
** VOLUME:  SRCID       QS           HS       SYINIT     SZINIT
** AREA:    SRCID       QS           HS       XINIT

SO SRCPARAM     5    100.00000       100.0000   416.0000    18.8000     4.6000
SO EMISUNIT    .100000E+07 (GRAMS/SEC)         (MICROGRAMS/CUBIC-METER)
SO SRCGROUP   5     5
SO SRCGROUP ALL
SO FINISHED

RE STARTING
  GRIDPOLR POL1 STA
  GRIDPOLR POL1 ORIG 0. 0.
  GRIDPOLR POL1 DIST 125. 250. 400. 800. 2000.
  GRIDPOLR POL1 GDIR 36 10. 10.
  GRIDPOLR POL1 END
RE FINISHED



ME STARTING
ME SURFFILE AERMET-O.SFC
ME PROFFILE AERMET-O.PFL
ME SURFDATA  13967  1984
ME UAIRDATA  13967  1984
ME WINDCATS    1.54    3.09    5.14    8.23   10.80
ME PROFBASE 0
ME FINISHED

OU STARTING
  RECTABLE ALLAVE FIRST SECOND
OU FINISHED
```

ISCST3 INPUT FILE FOR POINT SOURCE
TIMING ANALYSIS

```
CO STARTING
CO TITLEONE RURAL - 100 METER STACK - FLAT TERRAIN
CO TITLETWO
CO MODELOPT DFAULT CONC   RURAL
CO POLLUTID SO2
CO AVERTIME  PERIOD   1  3 24
CO DCAYCOEF    .000000
CO TERRHGTS ELEV
CO ELEVUNIT FEET
CO RUNORNOT RUN
CO ERRORFIL ERRORS.OUT
CO FINISHED

SO STARTING

** Source Location Cards:
**        SRCID SRCTYP       XS          YS          ZS
SO LOCATION     5 POINT         .0000        .0000        .0000

** Source Parameter Cards:
** POINT:   SRCID       QS           HS        TS         VS        DS
** VOLUME:  SRCID       QS           HS       SYINIT      SZINIT
** AREA:    SRCID       QS           HS       XINIT

SO SRCPARAM     5    100.00000       100.0000   416.0000    18.8000     4.6000
SO EMISUNIT    .100000E+07 (GRAMS/SEC)         (MICROGRAMS/CUBIC-METER)
SO SRCGROUP   5     5
SO SRCGROUP ALL
SO FINISHED

RE STARTING
  GRIDPOLR POL1 STA
  GRIDPOLR POL1 ORIG 0. 0.
  GRIDPOLR POL1 DIST 125. 250. 400. 800. 2000.
  GRIDPOLR POL1 GDIR 36 10. 10.
  GRIDPOLR POL1 END
RE FINISHED

ME STARTING
ME INPUTFIL   okc-84.asc
ME ANEMHGHT   10.000 METERS
ME SURFDATA  13967  1984           SURFNAME
ME UAIRDATA  13967  1984           UAIRNAME
ME WINDCATS    1.54    3.09    5.14    8.23   10.80
ME FINISHED

OU STARTING
  RECTABLE ALLAVE FIRST SECOND
OU FINISHED
```

AERMOD INPUT FILE FOR VOLUME SOURCE
TIMING ANALYSIS

```
CO STARTING
CO TITLEONE RURAL - VOLUME SOURCE - NO TERRAIN
CO MODELOPT  CONC   MSGPRO
CO AVERTIME  PERIOD   1  3 24
CO POLLUTID SO2
CO DCAYCOEF    .000000
CO RUNORNOT RUN
CO ERRORFIL ERRORS.OUT
CO FINISHED

SO STARTING
 ** Source Location Cards:
 **         SRCID SRCTYP       XS           YS           ZS
SO LOCATION     1 VOLUME        .0000        .0000        .0000
** Source Parameter Cards:
** POINT:   SRCID       QS           HS        TS         VS        DS
** VOLUME:  SRCID       QS           HS       SYINIT      SZINIT
** AREA:    SRCID       QS           HS       XINIT
SO SRCPARAM     1    100.00000       35.0000    14.0000    16.0000
SO EMISUNIT    .100000E+07 (GRAMS/SEC)         (MICROGRAMS/CUBIC-METER)
SO SRCGROUP ALL
SO FINISHED

RE STARTING
   GRIDPOLR POL1 STA
   GRIDPOLR POL1 ORIG 0. 0.
   GRIDPOLR POL1 DIST 125. 250. 400. 800. 2000.
   GRIDPOLR POL1 GDIR 36 10. 10.
   GRIDPOLR POL1 END
RE FINISHED

ME STARTING
ME SURFDATA  13967  1984
ME UAIRDATA  13967  1984
ME SURFFILE AERMET-O.SFC
ME PROFFILE AERMET-O.PFL
ME WINDCATS    1.54    3.09    5.14    8.23   10.80
ME PROFBASE 0
ME FINISHED

OU STARTING
OU RECTABLE ALLAVE FIRST  SECOND
OU FINISHED
```

ISCST3 INPUT FILE FOR VOLUME SOURCE TIMING ANALYSIS

```
CO STARTING
CO TITLEONE RURAL - VOLUME SOURCE - NO TERRAIN
CO MODELOPT DFAULT CONC   RURAL
CO AVERTIME  PERIOD   1  3 24
CO POLLUTID SO2
CO DCAYCOEF    .000000
CO TERRHGTS ELEV
CO ELEVUNIT FEET
CO RUNORNOT RUN
CO ERRORFIL ERRORS.OUT
CO FINISHED

SO STARTING
** Source Location Cards:
**        SRCID SRCTYP       XS          YS          ZS
SO LOCATION     1 VOLUME        .0000        .0000        .0000

** Source Parameter Cards:
** POINT:   SRCID      QS          HS        TS        VS        DS
** VOLUME:  SRCID      QS          HS      SYINIT     SZINIT
** AREA:    SRCID      QS          HS       XINIT

SO SRCPARAM     1    100.00000       35.0000    14.0000    16.0000

SO EMISUNIT    .100000E+07 (GRAMS/SEC)         (MICROGRAMS/CUBIC-METER)
SO SRCGROUP ALL
SO FINISHED

RE STARTING
  GRIDPOLR POL1 STA
  GRIDPOLR POL1 ORIG 0. 0.
  GRIDPOLR POL1 DIST 125. 250. 400. 800. 2000.
  GRIDPOLR POL1 GDIR 36 10. 10.
  GRIDPOLR POL1 END
RE FINISHED

ME STARTING
ME INPUTFIL okc-84.asc
ME ANEMHGHT    7.000 METERS
ME SURFDATA  13967  1984          SURFNAME
ME UAIRDATA  13967  1984          UAIRNAME
ME WINDCATS    1.54    3.09    5.14    8.23   10.80
ME FINISHED


OU STARTING
OU RECTABLE ALLAVE FIRST  SECOND
OU FINISHED
```

AERMOD INPUT FILE FOR AREA SOURCE

TIMING ANALYSIS

```
CO STARTING
CO TITLEONE RURAL - AREA SOURCE - NO TERRAIN
CO MODELOPT CONC   MSGPRO
CO AVERTIME  PERIOD   1  3 24
CO POLLUTID SO2
CO DCAYCOEF    .000000
CO RUNORNOT RUN
CO ERRORFIL ERRORS.OUT
CO FINISHED

SO STARTING
** Source Location Cards:
**        SRCID SRCTYP       XS          YS          ZS
SO LOCATION     1 AREA      -500.0000    -500.0000        .0000

** Source Parameter Cards:
** POINT:   SRCID      QS          HS        TS        VS        DS
** VOLUME:  SRCID      QS          HS      SYINIT     SZINIT
** AREA:    SRCID      QS          HS       XINIT

SO SRCPARAM     1    .10000000E-03    0.0000  1000.0000

SO EMISUNIT    .100000E+07 (GRAMS/SEC)         (MICROGRAMS/CUBIC-METER)
SO SRCGROUP ALL
SO FINISHED

RE STARTING
  GRIDPOLR POL1 STA
  GRIDPOLR POL1 ORIG 0. 0.
  GRIDPOLR POL1 DIST 125. 250. 400. 800. 2000.
  GRIDPOLR POL1 GDIR 36 10. 10.
  GRIDPOLR POL1 END
RE FINISHED


ME STARTING
ME SURFDATA  13967  1984
ME UAIRDATA  13967  1984
ME SURFFILE AERMET-O.SFC
ME PROFFILE AERMET-O.PFL
ME WINDCATS    1.54    3.09    5.14    8.23   10.80
ME PROFBASE 0
ME FINISHED


OU STARTING
OU RECTABLE ALLAVE FIRST  SECOND
OU FINISHED
```

ISCST3 INPUT FILE FOR AREA SOURCE

TIMING ANALYSIS

```
CO STARTING
CO TITLEONE RURAL - AREA SOURCE - NO TERRAIN
CO MODELOPT DFAULT CONC   RURAL
CO AVERTIME  PERIOD   1  3 24
CO POLLUTID SO2
CO DCAYCOEF    .000000
CO TERRHGTS ELEV
CO ELEVUNIT FEET
CO RUNORNOT RUN
CO ERRORFIL ERRORS.OUT
CO FINISHED

SO STARTING
** Source Location Cards:
**         SRCID SRCTYP       XS           YS           ZS
SO LOCATION     1 AREA       -500.0000     -500.0000         .0000

** Source Parameter Cards:
** POINT:   SRCID       QS           HS        TS         VS        DS
** VOLUME:  SRCID       QS           HS       SYINIT      SZINIT
** AREA:    SRCID       QS           HS       XINIT
SO SRCPARAM     1    .10000000E-03    0.0000  1000.0000

SO EMISUNIT    .100000E+07 (GRAMS/SEC)         (MICROGRAMS/CUBIC-METER)
SO SRCGROUP ALL
SO FINISHED

RE STARTING
  GRIDPOLR POL1 STA
  GRIDPOLR POL1 ORIG 0. 0.
  GRIDPOLR POL1 DIST 125. 250. 400. 800. 2000.
  GRIDPOLR POL1 GDIR 36 10. 10.
  GRIDPOLR POL1 END
RE FINISHED

ME STARTING
ME INPUTFIL okc-84.asc
ME ANEMHGHT    7.000 METERS
ME SURFDATA  13967  1984           SURFNAME
ME UAIRDATA  13967  1984           UAIRNAME
ME WINDCATS    1.54    3.09    5.14    8.23   10.80
ME FINISHED


OU STARTING
OU RECTABLE ALLAVE FIRST  SECOND
OU FINISHED
```