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AniMACCS User Guide

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ABSTRACT

This SAND Report provides an overview of AniMACCS, the animation software developed for the MELCOR Accident Consequence Code System (MACCS). It details what users need to know in order to successfully generate animations from MACCS results. It also includes information on the capabilities, requirements, testing, limitations, input settings, and problem reporting instructions for AniMACCS version 1.3.1. Supporting information is provided in the appendices, such as guidance on required input files using both WinMACCS and running MACCS from the command line.

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1. INTRODUCTION

1.1. Objective

AniMACCS is a utility code in the MELCOR Accident Consequence Code System (MACCS) software suite that allows for certain MACCS output information to be visually displayed and overlaid onto a geospatial map background. AniMACCS was developed by Sandia National Laboratories for the U.S. Nuclear Regulatory Commission.

MACCS is designed to calculate health and economic consequences following a release of radioactive material in the atmosphere. MACCS accomplishes this by modeling the atmospheric dispersion, deposition, and consequences of the release, which depend on several factors including the source term, weather, population, economic, and land-use characteristics of the impacted geographical area. From these inputs, MACCS determines the characteristics of the plume, as well as ground and air concentrations as a function of time and radionuclide.[1]

AniMACCS uses this information to animate the plume transport over time by displaying the data over a map background. Figure 1-1 below shows a screenshot of AniMACCS performing this function for the ground concentration of Cs-137.

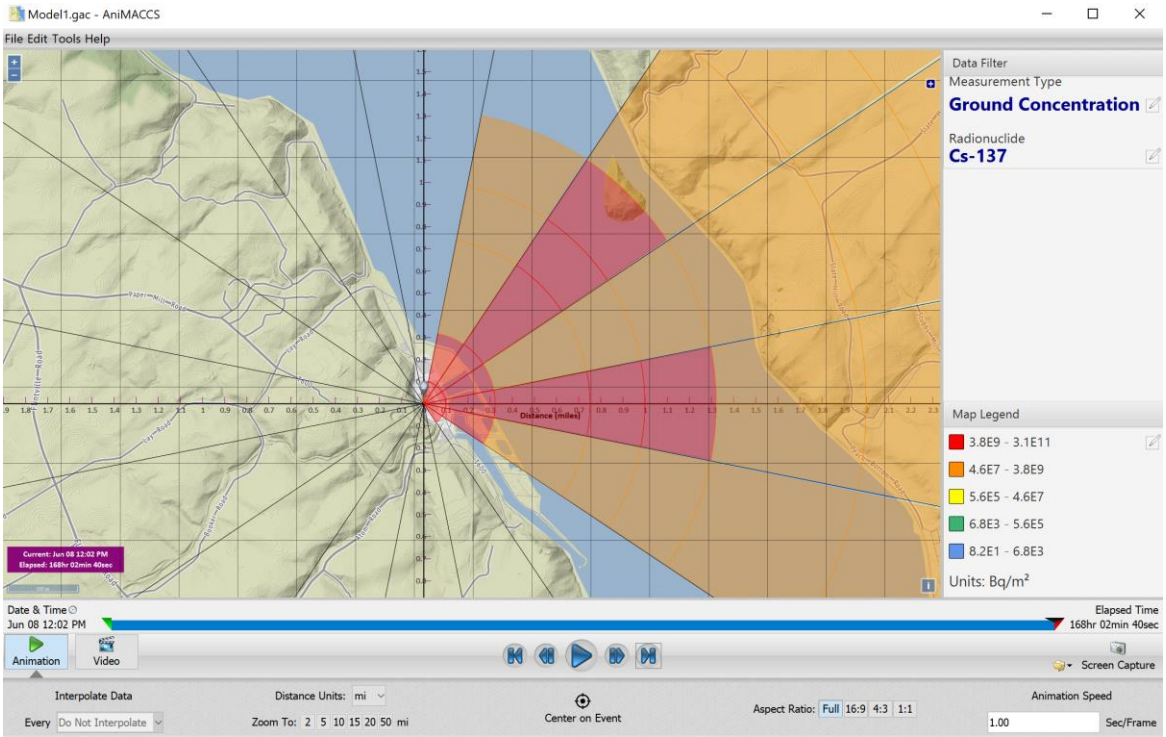

Figure 1-1. Screenshot of AniMACCS Ground Concentration Animation

1.2. Current Version

The initial publicly released version of AniMACCS is version 1.3. This user guide includes updates for version 1.3.1.

1.3. Requirements

MACCS version 4.0 or later is needed to generate the input files for AniMACCS. Internet access is required in order to use maps; however, AniMACCS can be run without internet access but it will produce animations over a blank background. Approximately 900 MB of hard drive space is required for installation of the program, with additional hard drive space required for saving images and videos created by AniMACCS. Four GB RAM is required for the application to run, although 16 GB is recommended to run AniMACCS and other applications simultaneously.

In order to have MACCS produce the files required by AniMACCS, the user needs to select "Create Plume Movement File" and/or "Create Ground and Air Concentration File" under the *Animation/Health Effects* tab under the *Project Properties* menu when using WinMACCS, as displayed in Figure 1-2 below. The user can select the number and names of radionuclides to include in the AniMACCS ground and air concentration input files in the MACCS *Early* module under *Output Control >> Animation Radionuclides*. Instructions to produce these files are provided in Appendix D for when MACCS is run from the command line. Note that the MACCS parameter IPLUME must equal 3. This corresponds to "wind shift without rotation" on the *Evac/Rotation* tab on the *Project Properties* menu, which is typically the recommended approach for analyses using currently recommended practices.

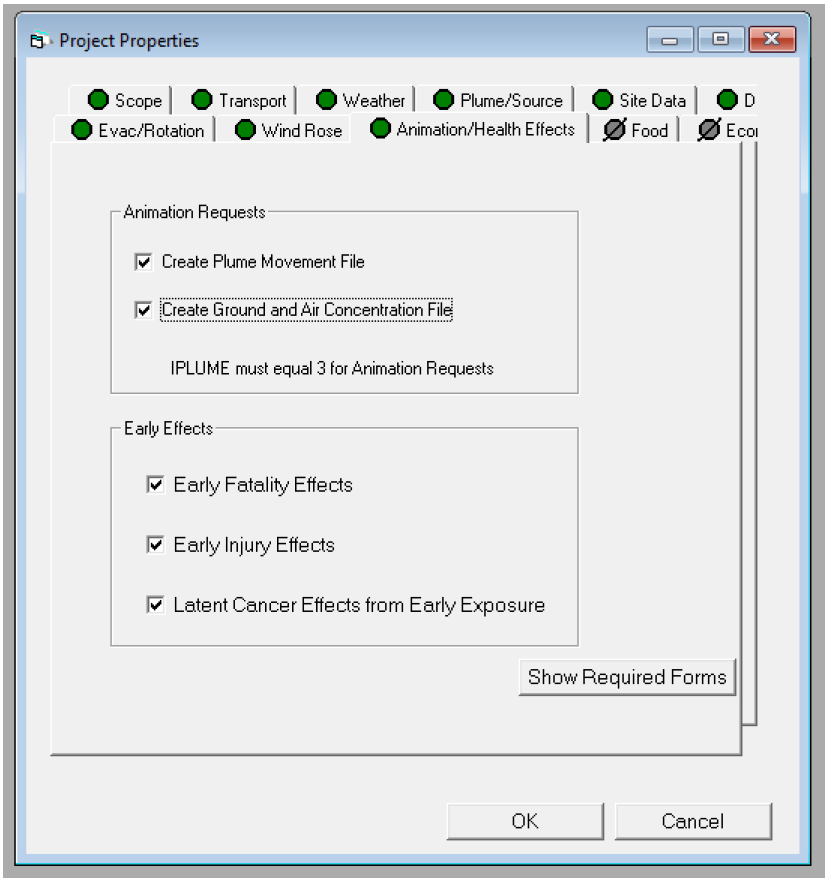

Figure 1-2. Selecting Animation Requests in the MACCS Project Properties Window

After MACCS runs the simulation(s), the animation files are available in the output folder for selection in AniMACCS. AniMACCS allows users the option to open .plum files (for plume segment movement animations) or .gac files (for air and ground concentration animations) to perform animations.

1.4. Verification and Testing

AniMACCS was specifically designed and tested on Windows 10 and is expected to be compatible with Windows Vista, 7, and 8. This software product has been extensively tested and verified to meet its requirements in accordance with Sandia National Laboratories' software quality assurance practices. Testing consisted of verifying all software requirements were met by running a series of test cases. This testing was conducted by individuals both internal and external to Sandia National Laboratories, with all testing documentation reviewed by a third individual for completeness and accuracy. Any issues identified were resolved and received additional testing to verify resolution was effective prior to release.

1.5. Current Limitations

AniMACCS is used to visualize the plume travel and resulting air and ground concentrations for individual weather trials, not for statistical results over multiple weather trials. MACCS Version 4.0 or later will produce one .plum file and/or one .gac file for each MACCS simulation. If MACCS is run with one of the weather sampling options, it creates animation files only for the first weather

trial. Animations are most useful when running MACCS in a single weather trial mode, most typically using a weather file with a starting day and hour. If the cyclical file option is selected, for example using 800 cyclical files, the animation files are named "Model1.plum" to "Model800.plum" and "Model1.gac" to "Model800.gac". One approach could be to run MACCS in typical weather sampling mode, then view the results and identify from the output file which weather trials produce the peak result of interest. Then re-run MACCS using cyclical files with a selected handful of weather trials of interest. This method would generate the .gac and .plum files corresponding to the specific weather sequences that lead to the maximum consequences. In the future, the capability to identify weather trials corresponding to statistical quantiles of each consequence may also be added.

The compass lines are drawn using a 2D circle and a fixed angle between each line. The map itself uses a Mercator projection. The plumes are drawn centered on the compass lines. At downrange distances, the location of the plumes shown may not match exactly to a point on the ground at that same direction heading, depending on the latitude.

1.6. Problem Reporting

AniMACCS has a built-in feature that allows users to submit feedback, report issues, and make recommendations for future releases. This feature can be found under "Submit Feedback" located in the help menu and it is displayed in Figure 1-3 below:

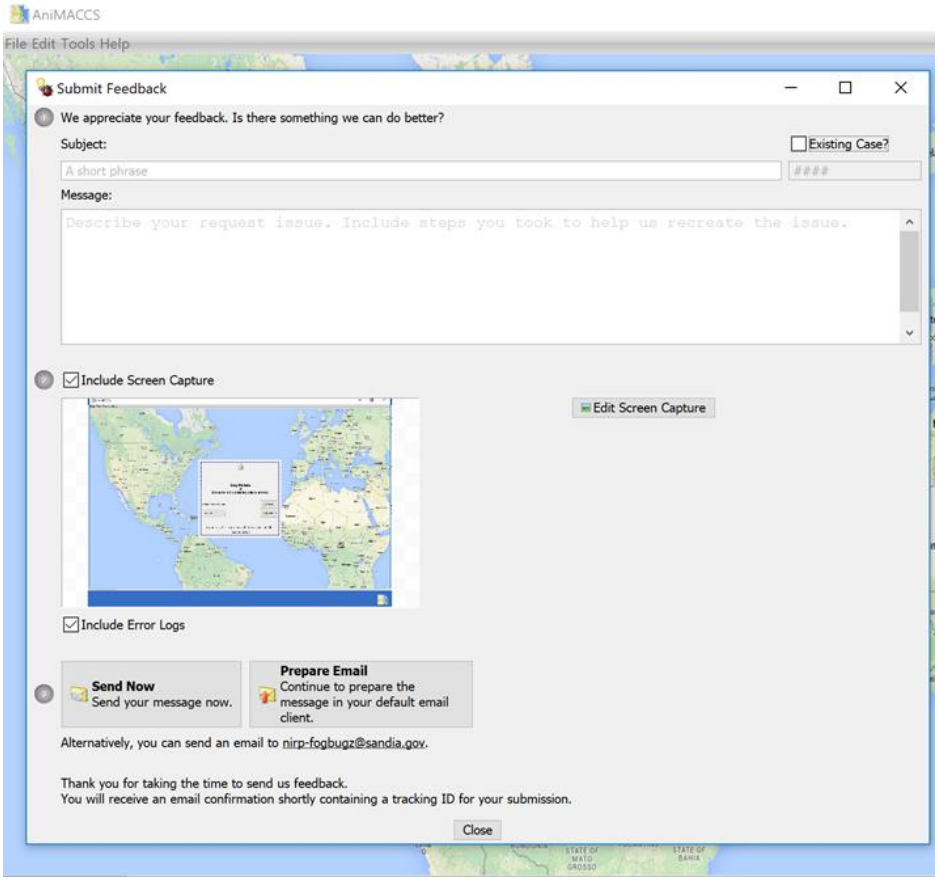

Figure 1-3. AniMACCS Feedback Submission Tool

Users are recommended to select "Prepare Email" rather than "Send Now" to ensure that the email works properly in the user's default email client. Users may also contact wg-maccs-entity@sandia.gov to submit any feedback, report any issues that are observed with this software, or to make recommendations for future releases. When reporting issues, users are encouraged to include as much information as possible, including screenshots if applicable. The AniMACCS software development team may request the user to provide the animation file that induced the error condition or crash so they can reproduce the issue. A member of the software development team will contact you with assistance or to confirm bug status, as appropriate. Users may also check the status of reported bugs and suggested features by accessing https://ersdt.fogbugz.com. For help with login instructions, contact wg-maccs-entity@sandia.gov.

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2. USER GUIDANCE

2.1. Capabilities

AniMACCS reads plume segment movement files (.plum) and ground and air concentration files (.gac) created by MACCS and animates them over a map of the geographical area. Users may zoom in or out, drag the map to move the release location off-center, play the animation, modify animation start and end times, speed up or slow down the animation, modify units, modify display colors, perform custom interpolations, choose layers that are displayed, create snapshots, and export animations to video files.

2.2. Start Screen

The Start screen (displayed in Figure 2-1 below) provides a user interface to select the MACCS generated file to be animated, control the interpolation rate, and export sample files. These features are indicated by the numbered arrows in Figure 2-1, and further described in the text below.

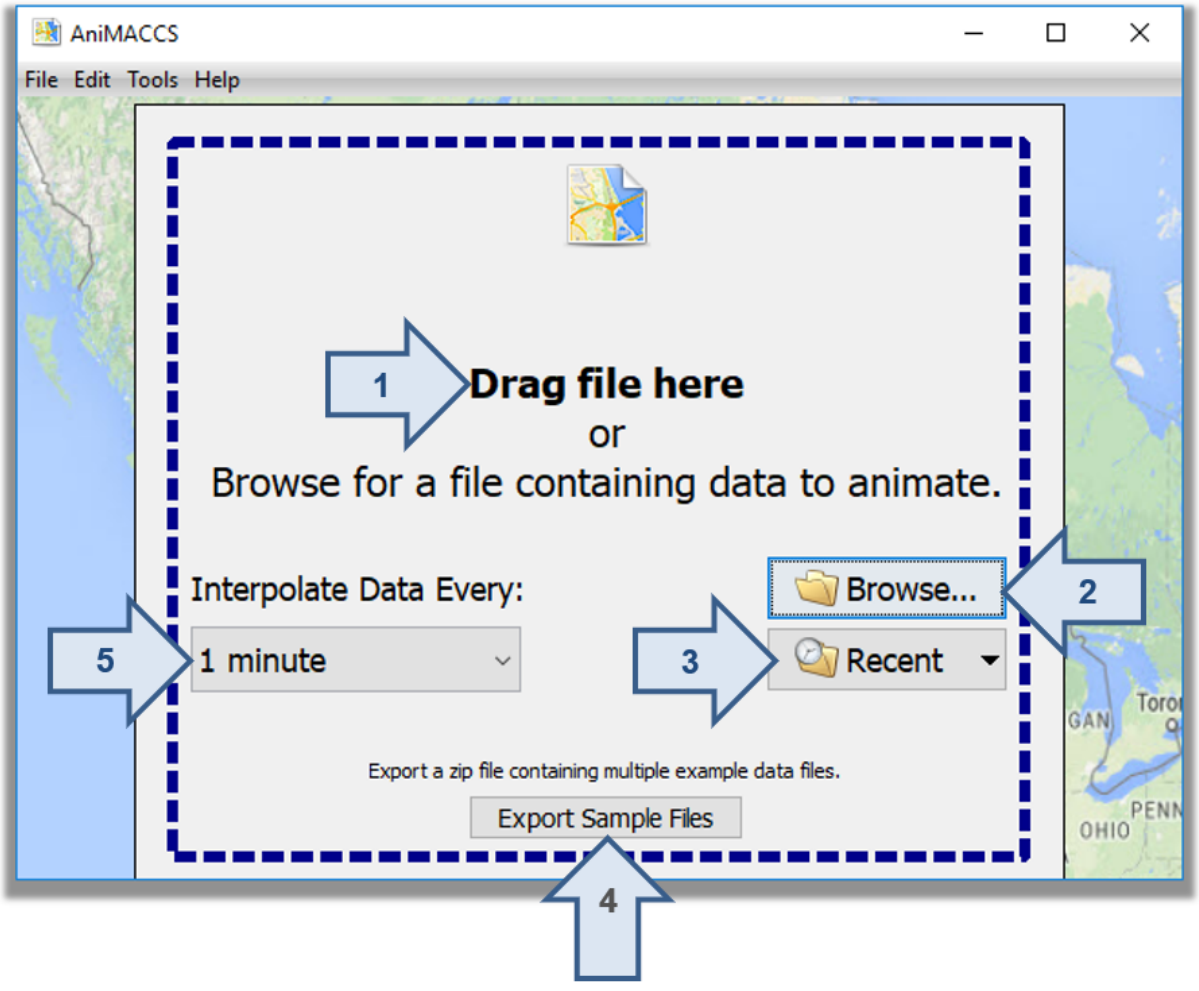


Figure 2-1. Start Screen

Drag File Here

1

Drag a GAC (Ground and Air Concentration) or PLUM (Plume Segments) file to the screen to open the file in AniMACCS.

Open Data File

2

Click **Browse** to open animation files supported by AniMACCS as an alternative to the Drag File Here option. The supported file formats have a GAC or PLUM file extension.

Open Recent

3

Click **Recent** to open animation files recently opened with AniMACCS.

Export Sample Files

4

Click **Export Sample Files** to export a zip file containing example GAC and PLUM files.

Interpolate Data

5

Click the combo box under **Interpolate Data Every** to change how often the data are interpolated. An option to not interpolate is also available. Note, only PLUM files may be interpolated. Interpolation moves the leading and trailing edges of the plume segments at the average speed between data points recorded in the file in order to smooth the animation.

The interpolation speed (N in pixels/minute) depends on wind speed (V in miles/hour), the number of pixels corresponding to the radius of the grid (P), and the radius of the grid (R in miles) using the following relationship:

$$N = (V \times P)/(R \times 60)$$

Interpolation time (T in minutes) is proportional to 1/N. For smooth animations, a rule of thumb recommendation is to set the interpolation time

$$T = R/60$$

Users may also prefer to select a larger interpolation time to speed up animations.

Interpolation Example: For example, if a user's grid has a radius of 100 miles, a good interpolation time would be approximately 1-2 minutes.

2.3. Menu Bar

The Menu Bar (displayed in Figure 2-2 below) provides users options to select files, edit time zones, modify network settings if needed for specific network requirements, submit feedback, access the user guide, control interpolation rate, and access current code version information. These features are indicated by the numbered arrows in Figure 2-2, and further described in the text below.

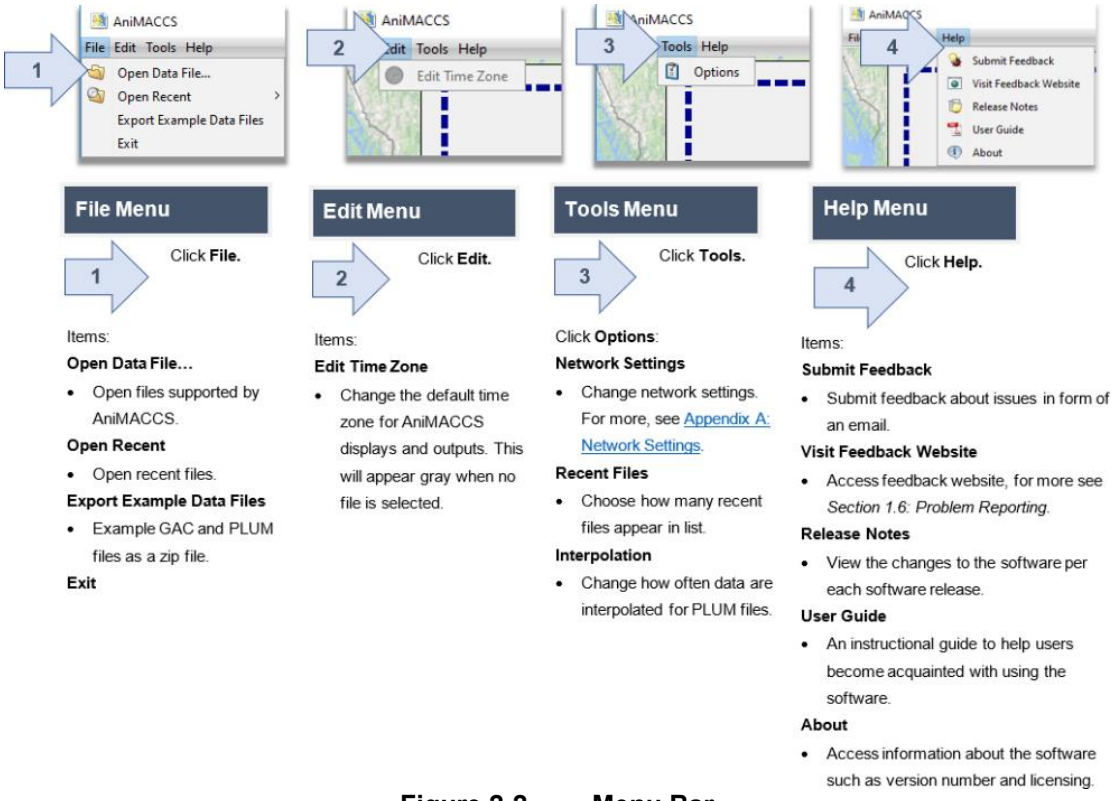


Figure 2-2. Menu Bar

2.4. Map Controls

Map controls are accessible once a map is loaded and provide users the ability to zoom, switch layers, make measurements, select radionuclides, edit ranges, display attributes, display time frame labels, control scale associated with isopleths, pan, and zoom to point. These features are indicated by the numbered arrows in Figure 2-3, and further described in the text below.

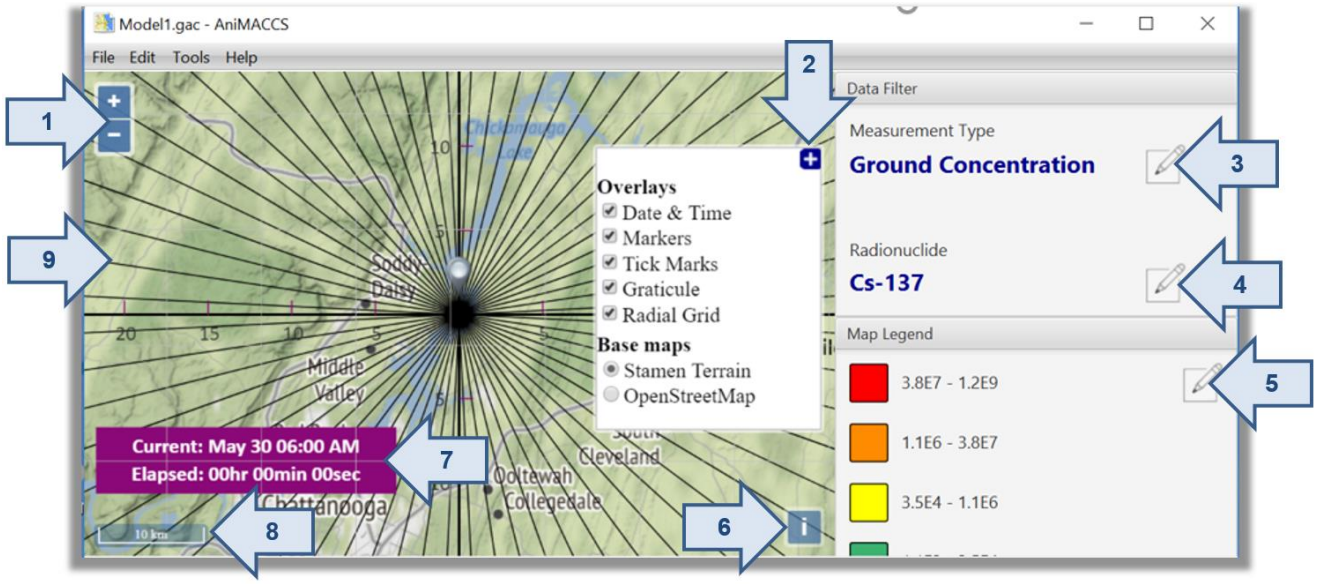


Figure 2-3. Map Controls

Zoom Tool

1

Click the + symbol to zoom in on the center of the map.

Click the − symbol to zoom out from the center of the map.

Radionuclide

4

Click the  symbol to change the radionuclide for the GAC files shown on the map. Changing the radionuclide also affects the ranges displayed in the Map Legend.

Layer Switcher

2

Hover the mouse over the + symbol on the right side of the map to reveal the Layer Switcher tool. **Overlays** are layers that are on top of the base map and can be hidden or shown. Currently, under **Base maps**, two options are available that show streets, terrain, points of interests, and many other features across the world. The default setting is **Stamen Terrain** because it generally downloads map panels more rapidly.

Measurement Type

3

Click the  symbol to change the measurement type for the GAC files shown on the map.

Options include Ground Concentration, Time Integrated Air Concentration, and Air Concentration. Changing the measurement type also affects the ranges in the Map Legend.

Map Legend

5

Click the  symbol to change the contour ranges. Currently, five contour ranges are available. The **Range Editor** panel allows you to change colors for each range, the lower and upper bound for each range, and the units for all the ranges. Additionally, there are options to **Apply Default Colors** to all ranges, **Apply Monochrome Colors** to all ranges, and **Equalize Ranges**. **Equalize Ranges** resets all ranges to be evenly spaced between the minimum and maximum values. The user also has the ability to name their different ranges however these names are not shown in the animation view screen.

Attribution

6

Click the i symbol to show the attribution information for the layer source such as copyright for a base map provider.

Time Frame Label

7

Displays information about the current time frame the map display is showing. This display includes the current time of the frame and the elapsed time since the start.

Scale Line

8

A control displaying rough y-axis distances, calculated for the center of the map viewport. Currently, units are displayed in the metric system by default.

Mouse Controls

9

Panning: Holding down the left, middle, or right mouse button moves the mouse and pans in the direction the mouse is moved.

Zoom to Point: Placing the mouse cursor on a specific point and rolling the mouse wheel forward zooms in to the point, while rolling the mouse wheel backward zooms out from the point. Double-clicking on a specific point on the map with the left mouse button also zooms to that point.

2.5. Animation/Video Controls

Animation/video controls are accessible once a map is loaded and provide users the ability to zoom, switch layers, make measurements, select radionuclides, edit ranges, display attributes, display time frame labels, control scale, pan, and zoom to point. These features are indicated by the numbered arrows in Figure 2-4, and further described in the text below.

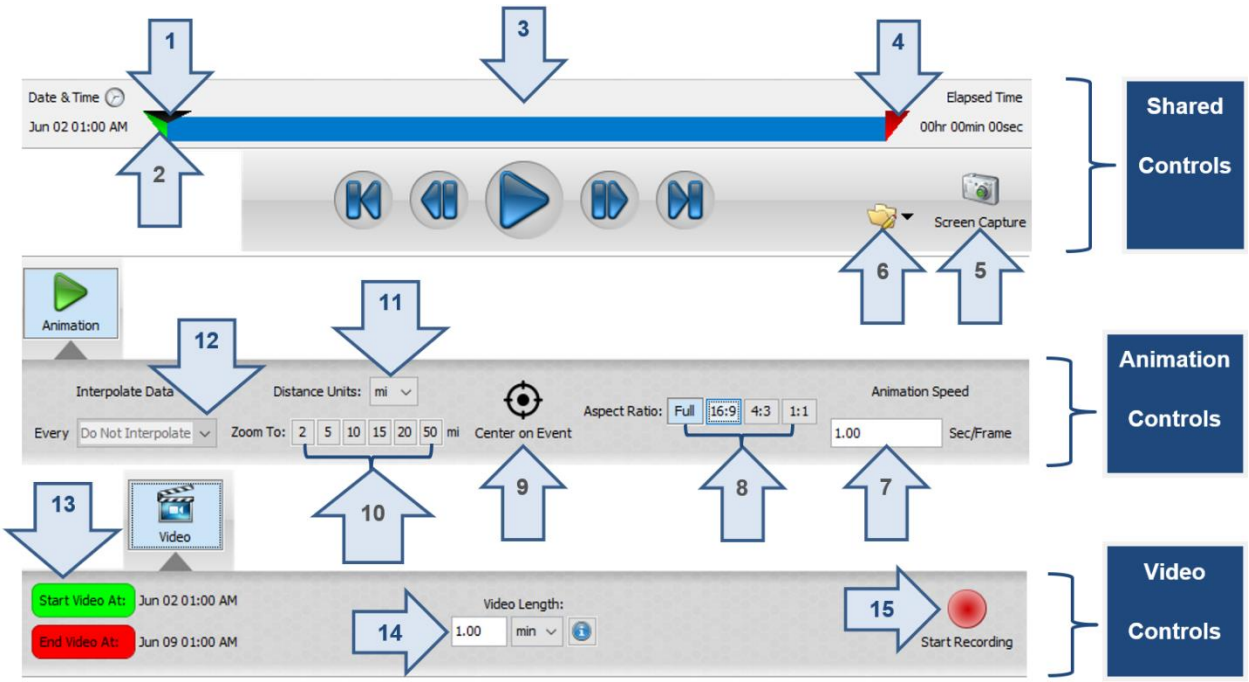


Figure 2-4. Animation/Video Controls

Playback Slider

1 Click and hold ▼ symbol to change the current animation or video by moving the mouse either forward or backward. Note the map display as well as time frame label are updated.

Start Slider

2 Click and hold ◥ symbol to change the current animation or video start time by moving the mouse either forward or backward. Note the map display as well as time frame label are updated since the **Playback Slider** is repositioned. Additionally, the **Start Video At** label is updated.

Playback Controls

3 Five playback controls are available to control various aspects of animation playback.

⏮	Steps back to first frame. Dependent on position of **Start Slider.**
⏭	Steps forward to last frame. Dependent on position of **End Slider.**
⏪	Steps back to the previous frame.
⏩	Steps forward to the next frame.
▶	Plays the animation frame from the current position of the **Playback Slider**.

End Slider

4 Click and hold ◤ symbol to change the current animation or video end position by moving the mouse either forward or backward. Note the map display as well as time frame label are updated since the **Playback Slider** is repositioned. Additionally, the **End Video At** label is updated.

Screen Capture

5 Click the Screen Capture button to take a snapshot of the current map frame symbol. A save file dialog appears asking for a location to save the screenshot.

Screen Capture Folder

6 Click the  button to open or change the location of the screen capture folder.

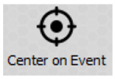
Animation Speed

7 The Animation Speed field controls the speed of animation playback based on how many seconds are desired to stay on a frame. It is recommended that users select animation speed based on the speed on their internet connection in order to render videos effectively.

Aspect Ratio

8 Four options are provided to select the aspect ratio of the map view. These options are Full, 16:9, 4:3, and 1:1.

Center on Event

9 Click 

to center the map over the event (release) location.

Zoom To Options

10 Click one of the six **Zoom To** options to zoom to a distance in miles from center. Options are 2, 5, 10, 15, 20, and 50 miles.

Distance Units

11 Click the 

combo box to change the distance units for the **Radial Grid** overlay layer labels on the map.

Interpolate Data

12 Choose an option in the 

combo box to change how often the data are interpolated. An option to not interpolate is also available. Note, this is currently only available for PLUM files.

Start Video/End Video Labels

13 These labels are used as a visual indicator to show what time frame the video will start at and what time frame the video will end at.

Video Length

14 Use the specified field to enter the desired duration for video playback. The duration can be specified in minutes or seconds. Unlike animation playback, no frames are skipped when a video is generated.

Start Recording

15 Click the 

button to start recording a video from the **Start Slider** position to the **End Slider** position. When the button is first clicked, a save file dialog appears asking for a name and location of the video file. Note: when **Start Recording** is selected the animation starts again from the beginning.

REFERENCES

1. Leute, J., F. Walton, R. Mitchell, and L. Eubanks. *MACCS (MELCOR Accident Consequence Code System) User Guide and Reference Manual*. SAND2021-8998. Sandia National Laboratories. Albuquerque, NM, 2021.

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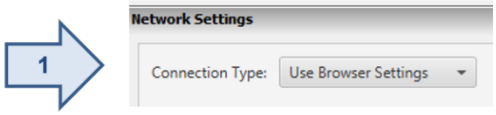
Appendix A. Network Settings

The following provides guidance on default network settings. These default settings may need to be modified based on individual network requirements. It is recommended that users experiencing difficulty with their network settings should contact their technical support representatives for assistance.

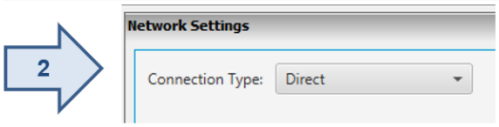
Use Browser Settings



This is the default option. If **Use Browser Settings** is selected, then proxy information is obtained entirely through the browser. To change proxy information, see the documentation for your browser:

- Internet Explorer:
  - *Change proxy settings in Internet Explorer* (Windows Vista, Windows 7, Windows 8)
  - *Configure Proxy Settings for Internet Explorer* (Windows Server 2008 R2)
- Firefox: Change proxy settings in the *Options window - Advanced panel*
- Chrome: Chrome uses the same connection and proxy settings as Windows; follow the same steps as you would with Internet Explorer

Direct



Direct connection does not use a proxy. For certain situations, such as when mobile users connect to the company through a modem, direct connection to the intranet environment is required, and proxies should not be used in these cases.

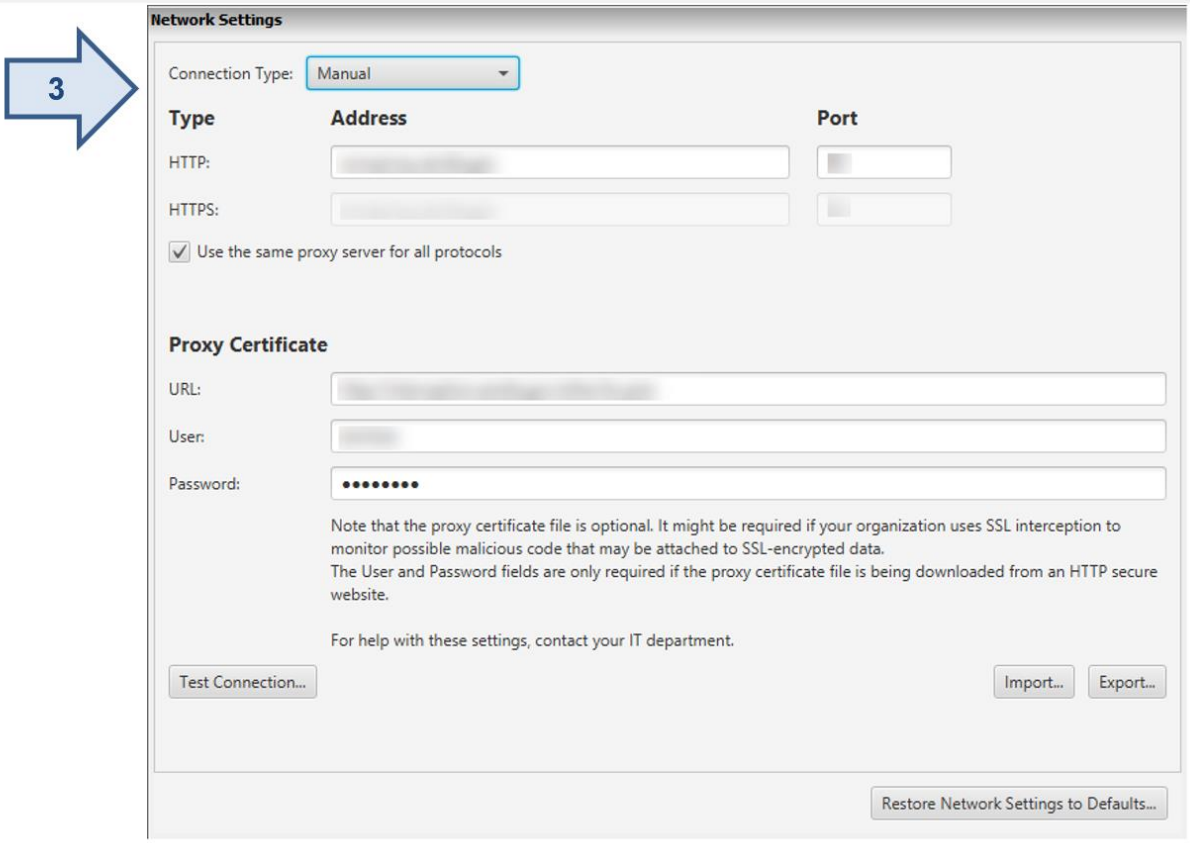


Figure A-1. Network Settings – Manual Connection

Manual

3

Type/Address/Port

- HTTP – The IP address/hostname of the proxy server to use for HTTP requests.
- HTTPS – The IP address/hostname of the proxy server to use for HTTPS requests.
- The port used by the proxy server. Typically, port 80.

Note: Select "Use the same proxy server for all protocols" to use the same for both HTTP and HTTPS. This is true in most situations.

Proxy Certificate

- Note that the proxy certificate file is optional which can be specified in the URL field. It might be required if your organization uses SSL interception to monitor possible malicious code that may be attached to SSL-encrypted data. The username and password fields are only required if the proxy certificate file is being downloaded from an HTTPS website.

Test Connection

- Click this button to test your settings.

Import

- Import proxy settings from a file.

Export

- Export your current proxy settings to a file as a additional backup.

Restore Network Settings to Defaults

- This button will restore the network settings to the defaults, which is the **Use Browser Settings** option.

Appendix B. Ground and Air Concentration File

The following table provides a description of the ground and air concentration file inputs by variable name. Each variable is listed in terms of its description, type, dimensions, and allowed values. An example input is also provided in the second column. Note that when MACCS creates .plum and .gac files, it uses the latitude and longitude from the values in WinMACCS under *ATMOS* >> *Weather* >> *Site Location* which may or may not be different from the site coordinates used in the site file. Also note that the AniMACCS variable *ATDMODEL* is not actually used in the code despite appearing in a .gac file.

Table B-1. Ground and Air Concentration Files

Variable Name	Example	Description	Type	Dimensions	Allowed Values
LATITU001	LATITU001, 35.2267	The latitude for the site location.	Real	None	-90.0 to 90.0˚
LONGIT001	LONGIT001, -85.0911	The longitude for the site location.	Real	None	-180.0 to 180.0˚
NUMRAD001	NUMRAD001, 29	The number of radial spatial intervals.	Integer	None	2 to 35
SPAEND001-SPAEND029	SPAEND001, 160.90	Defines the radial boundaries in the spatial grid.	Real	NUMRAD001	0.05 to 9999.0 Spacing ≥ 0.1 km
NUMCOR001	NUMCOR001, 64	The number of sectors in the spatial grid.	Integer	None	16, 32, 48, 64
DATTIM001	DATTIM001, 5, 30, 6, 0	The start time of release for the risk dominant ground and air concentration segment.	Integer	None	Order must be: Month, day, hour, seconds Ranges: Month – [1,12] Day – [1,31] Hour – [0,23] Seconds – [0,59]
ATDMODEL	ATDMODEL, HYSPLIT	The ATD model type used to generate the animation file.	Character	None	GAUSSIAN or HYSPLIT

Variable Name	Example	Description	Type	Dimensions	Allowed Values
DATABLOCKCOLUMNS	DATABLOCKCOLUMNS, 5	The number of data block columns for the BEGINDATABLOCK section.	Integer	None	Any number greater than or equal to 3.
DATACOLUMNDEF	DATACOLUMNDEF, RADIAL,ANGLE,Ground Concentration,Time Integrated Air Concentration,Air Concentration	The definitions of what each column of data represents. Column 1 = Radial index Column 2 = Angle index Column 3 = Ground Conc. Column 4 = Time Integrated Air Concentration Column 5 = Air Concentration	Character	DATABLOCKCOLUMNS	String representation of column header.
DATAUNITS	DATAUNITS,NONE,NONE,Bq/m3,Bq-s/m3,Bq/m3	The definitions of what units each column of data is in.	Charater	DATABLOCKCOLUMNS	N/A
BEGINNUCLIDE	BEGINNUCLIDE, 1	The start of a nuclide section with unique number for section.	Integer	None	Any number greater than or equal to 1.
NUCNAME	NUCNAME, Cs-137	The name of the nuclide.	Character	None	String representation of a nuclide such as Cs-137
BEGINTIMESTEP	See Example Below	The beginning of a timestep section.	None	None	N/A

Variable Name	Example	Description	Type	Dimensions	Allowed Values
TIME	TIME, 0.00	The time used for the time step in seconds.	Real	None	Any number greater than or equal to 0.
BEGINDATABLOCK	See Example Below	The start of the data block section. Column 1 = Radial index Column 2 = Angle index Column 3 = Ground Conc. Column 4 = Time Integrated Air Conc. Column 5 = Air Conc.	Integer, Integer, Real, Real, Real	5	Column 1: 1-35, Column 2: 1-64, Columns 3-5: Any value greater than or equal to 0
ENDDATABLOCK	ENDDATABLOCK	The end of the data block section which started on line preceding BEGINDATABLOCK.	N/A	N/A	N/A

Example Ground and Air Concentration File:

*Lines beginning with a * character are comment lines

*Latitude degrees
LATITU001, 35.2267
*Longitude degrees
LONGIT001, -85.0911
* Number of Radial Spatial Elements
NUMRAD001,29
* Spatial Endpoint Distances (meters)
SPAEND001, 160.90
SPAEND002, 556.00
SPAEND003, 1207.00
* The above lines continue until:
SPAEND029, 1609344.00
* Number of angular compass directions
NUMCOR001,64

```
*
* Month, day, hour, seconds
DATTIM001, 5,30,  6,   0
*
ATDMODEL,GAUSSIAN
*
* All time is in seconds.
*
* DATABLOCK Column descriptions (each column is separated by a comma).
* Radial ring, Angular compass direction, Ground Concentration, Time Integrated Air Concentration, Air Concentration
* DATABLOCK Column units.
* NONE,NONE,Bq/m2,Bq-s/m3,Bq/m3
* Each data line describes a grid element.
*
DATABLOCKCOLUMNS, 5
DATACOLUMNDEF,RADIAL,ANGLE,Ground Concentration,Time Integrated Air Concentration,Air Concentration
DATAUNITS,NONE,NONE,Bq/m2,Bq-s/m3,Bq/m3
*
* Radionuclide  1
BEGINNUCLIDE, 1
NUCNAME,Cs-137
BEGINTIMESTEP
TIME,       0.00
BEGINDATABLOCK
ENDDATABLOCK
ENDTIMESTEP
BEGINTIMESTEP
TIME,    6480.00
BEGINDATABLOCK
ENDDATABLOCK
ENDTIMESTEP
BEGINTIMESTEP
TIME,    7380.00
BEGINDATABLOCK
 1, 3,  2.26E-01,  3.35E+01,  4.13E-02
 1, 4,  7.24E-01,  1.38E+02,  1.70E-01
 1, 5,  1.51E+00,  1.69E+02,  2.09E-01
* The above lines continue until:
27,64,  1.93E+02,  6.55E+04,  0.00E+00
*
ENDDATABLOCK
ENDTIMESTEP
ENDNUCLIDE, 1
```

Appendix C. Plume Segment Movement File

The following table provides a description of the plume segment movement file inputs by variable name. Each variable is listed in terms of its description, type, dimensions, and allowed values. An example input is also provided in the second column. Note that when MACCS creates .plum and .gac files, it uses the latitude and longitude from the values in WinMACCS under *ATMOS* >> *Weather* >> *Site Location* which may or may not be different from the site coordinates used in the site file.

Table C-1. Plume Segment Movement File

Variable Name	Example	Description	Type	Dimensions	Allowed Values
LATITU001	LATITU001, 35.2267	The latitude for the site location.	Real	None	-90.0 to 90.0˚
LONGIT001	LONGIT001, -85.0911	The longitude for the site location.	Real	None	-180.0 to 180.0˚
NUMRAD001	NUMRAD001, 29	The number of radial spatial intervals.	Integer	None	2 to 35
SPAEND001-SPAEND029	SPAEND001, 160.90	Defines the radial boundaries in the spatial grid.	Real	NUMRAD001	0.05 to 9999.0 Spacing ≥ 0.1 km
NUMCOR001	NUMCOR001, 64	The number of sectors in the spatial grid.	Integer	None	16, 32, 48, 64
DATTIM001	DATTIM001, 5, 30, 6, 0	The start time of release for the risk dominant ground and air concentration segment.	Integer	None	Order must be: Month, day, hour, seconds Ranges: Month – [1,12] Day – [1,31] Hour – [0,23] Seconds – [0,59]

Variable Name	Example	Description	Type	Dimensions	Allowed Values
BEGINPLMSEG	BEGINPLMSEG, 1	The start of a plume segment section with unique number for section.	Integer	None	Any number greater than or equal to 1.
DIRECTION	DIRECTION, 8	The compass direction of the plume segment.	Integer	NUMCOR001	[1, NUMCOR001]
BEGINDATABLOCK	See Example Below	The start of the data block section. Column 1 = Time offset in seconds from DATTIM001 Column 2 = Leading edge distance (m) Column 3 = Trailing edge distance (m) Column 4 = Leading edge width (m) Column 5 = Trailing edge width (m)	Real, Real, Real, Real, Real	5	Column 1, 2, 3, 4, 5 = Value greater than or equal to 0
ENDDATABLOCK	ENDDATABLOCK	The end of the data block section which started on line BEGINDATABLOCK 1.	N/A	N/A	N/A
ENDPLMSEG	ENDPLMSEG, 1	The end of a plume segment section that started on line BEGINPLMSEG, 1.	Integer	None	Any number greater than or equal to 1.

Example Plume Segment Movement File:

*Lines beginning with a * character are comment lines

```
*
*Latitude degrees
LATITU001,   35.2267
*Longitude degrees
LONGIT001,  -85.0911
* Number of Radial Spatial Elements
NUMRAD001,29
* Spatial Endpoint Distances (meters)
SPAEND001,     160.90
SPAEND002,     556.00
SPAEND003,    1207.00
* The above lines continue until:
SPAEND029, 1609344.00
* Number of angular compass directions
NUMCOR001,64
*
* Month, day, hour, seconds
DATTIM001, 5,30,  6,   0
*
* All time is in seconds and all distances are in meters.
* Time,Leading edge distance,Trailing edge distance),Leading edge width,Trailing edge width
* Plume segment    1
BEGINPLMSEG,   1
* Direction
DIRECTION, 8
BEGINDATABLOCK
   6480.00,       0.00,       0.00,       0.00,       0.00
   6569.39,      80.45,       0.00,      73.44,       0.00
* The above lines continue until:
865857.56, 1408176.00, 1408176.00,  265627.22,  265627.22
ENDDATABLOCK
ENDPLMSEG,   1
*
* Plume segment    2
BEGINPLMSEG,   2
* Direction
DIRECTION, 8
BEGINDATABLOCK
   6480.00,       0.00,       0.00,       0.00,       0.00
   6569.39,      80.45,       0.00,      73.44,       0.00
* The above lines continue until:
865857.56, 1408176.00, 1408176.00,  265751.16,  265751.16
ENDDATABLOCK
ENDPLMSEG,   2
*Continue to add plume segments as needed
```

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Appendix D. Command Line Instructions

If using the command line to execute MACCS, rather than using WinMACCS as the user interface, the following lines need to be included in the EARLY input file. Lines in the following examples beginning with * are interpreted by MACCS as comment lines.

Only one CARD is required for the plume movement (.plum) animation file:

```
* flag to create animation file describing plume movement (values can be .TRUE. or .FALSE., if value is
* .TRUE. then a plume movement file is created)

VIANIPLM001    .TRUE.
```

The following 3 CARDs are required to create a ground and air concentration (.gac) animation file:

```
* flag to create animation file containing ground and air concentrations (values can be .TRUE. or
.FALSE.,
* if value .TRUE. then a ground and air concentrations animation file will be created)

VIANIGAC001    .TRUE.

* The next two CARDs are only required if VIANIGAC001 has a value of .TRUE.
* Number of radionuclides included in a ground and air concentration (.gac) animation file

VINUMNUC001 3

* List of radionuclides to report concentrations in a .gac animation file. Each radionuclide is listed on a
* separate line as shown below. The following lists example radionuclides, which may be expanded to
* include additional radionuclides as desired by the user.

VINUCPLT001  Cs-134
VINUCPLT002  Cs-136
VINUCPLT003  Cs-137
```

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