

AIR SCIENCES INC.

Users Guide: Smoke Impact Spreadsheet (SIS) Model

Prepared for:
**U. S. Department of
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CONTENTS

Page

| | |
|---|----|
| 1 WHAT IS THE SIS MODEL? | 1 |
| 2 INSTALLING SIS | 2 |
| System Requirements | 2 |
| Installing SIS on Your Computer | 2 |
| Installing FOFEM5 | 3 |
| Installing CONSUME 2.1 | 3 |
| Microsoft Excel Considerations | 4 |
| Additional Help | 4 |
| 3 RUNNING SIS | 5 |
| Understanding the SIS Model Architecture | 5 |
| Main SIS Folder | 5 |
| Project Folders | 5 |
| EXEC Folder | 6 |
| Starting Up the Model | 6 |
| Inside SIS—Understanding the Spreadsheet Architecture | 9 |
| “Load Existing Scenario” Command Button | 10 |
| “Create New Scenario” Command Button | 10 |
| “Run Emissions Model” Command Button | 11 |
| FOFEM5 | 12 |
| CONSUME 2.1 Pile Wizard | 14 |
| “Run SIS and Save!” Command Button | 16 |
| Run Inputs | 17 |
| Emissions Table | 17 |
| Concentration Table | 18 |
| Emissions and Concentration Charts | 19 |
| “Make Puff Chart” Command Button | 21 |
| Main Worksheet Inputs | 21 |
| Scenario Group | 22 |
| Burn Group | 22 |
| Broadcast Burn Description | 24 |
| Wildfire Description | 25 |
| Pile Burn Group | 26 |
| Meteorological Group | 28 |
| Terrain Group | 29 |
| 4 REFERENCES | 31 |

Tables

| | |
|---|----|
| Table 3-1: Suggested fuel moisture contents by fire type and season of burn | 12 |
|---|----|

Appendices

- A Troubleshooting and Installation Issues
- B Guidance for First Order Fire Effects Model (FOFEM5)
- C Burn Characterization in the SIS Model

WHAT IS THE SIS MODEL?

The Smoke Impact Spreadsheet (SIS) model is a simple-to-use, screening-level modeling system for calculating PM_{2.5} emissions and airborne concentrations downwind of natural or managed wildland fires. As a screening model, SIS provides conservative (that is, tending toward higher-than-actual) predictions of the downwind air concentrations at user-selected receptors for comparison with appropriate federal or state air quality standards for particulate matter less than 2.5 microns in diameter (PM_{2.5}).

The SIS model has three main components:

- A graphic user interface based on a series of Excel spreadsheets for easy data entry, model execution, and display of results
- An emissions module that calculates emissions for broadcast and wild fire burns using the First Order Fire Effects Model, version 5 (FOFEM5), and from pile burns using the CONSUME 2.1 pile wizard
- A dispersion module that uses the CALPUFF dispersion model (version 5.5)

The SIS model evaluates the ground-level smoke plume impacts for up to 10 co-located burn units (wildland fires, broadcast burn units, pile burn units), each with different areas and start times, using a single set of hourly varying meteorological conditions (wind speed, ambient temperature, stability class, mixing height) provided by the user. The model can be run assuming flat terrain, or using a simplified terrain profile provided by the user.

INSTALLING SIS

System Requirements

To load and run SIS, you will need to have available on your computer:

- SIS self-extracting zip file (current version is SIS04202003.exe)
- Current version of FOFEM5
- Installed version of CONSUME 2.1 [or a current version of the Fire Effects Tradeoff Model (FETM) Version 4.5+]
- Microsoft Excel

The following subsections describe how to obtain and load these component programs.

Installing SIS on Your Computer

The SIS model is distributed via CD or website in a self-extracting ZIP file. The current installation file is identified as "SIS04202003.exe." The version number is embedded in the installation file name (the embedded string "04202003" designates the version released on April 20, 2003). Note that the version number—consequently the installation file name—will change every time a modification is made to the model. Please contact Ann Acheson (406-329-3496) for information on how to obtain the most recent version of SIS.

To load the SIS model on your computer, navigate to the "SIS04202003.EXE" file using Windows Explorer and double-click on the file. A "WinZip Self Extractor" window will appear asking you to name the folder where the model will reside. You may use the default directory, "C:\SIS", or name your own.

Note: Any letters or characters may be used to name your files, folders, and directories, but do not add any spaces. For example, you may name a folder "C:\smoke-models" or "C:\SmokeModels", but not "C:\smoke models."

After naming the folder, click on the "Unzip" command button to extract the model in the target location. When the extraction is finished, click on the "OK" button. Then "Close" the WinZip Self-Extractor window.

Note: Once you select a destination folder, a "SIS" subfolder will be created to store the model files. For example, if you select a target location of "C:\models", the program will create the destination folder "C:\models/SIS."

Installing FOFEM5

Download the FOFEM5 install program from the following web page:

<http://fire.org/cgi-bin/nav.cgi?pages=fofem&mode=8>

Click on the version of the model best suited for your computer: fof2000_inst.exe for Windows NT or 2000 users, or fof98_inst.exe for Windows 95 and 98 users. Once downloaded, execute the install program and follow the instructions in the install program. Be sure to install FOFEM5 on the C:\ drive of your computer.

Installing CONSUME 2.1

Note: You do not need to install CONSUME 2.1 on your personal computer *if* FETM Version 4.5 or later is already installed and operating. For more information on FETM, see:

<http://www.fs.fed.us/r6/aq/fetm>

Download the CONSUME 2.1 installation program (CONSUME21.exe) from the USDA Forest Service Pacific Northwest Research Fire and Environment Research Applications (FERA) Team web site:

<http://www.fs.fed.us/pnw/fera/products/consume.html>

Once downloaded, double click the "CONSUME21.exe" (a self-extracting zip file) to execute the file. A WINZIP Self-Extractor dialog box will appear. Enter the name of a temporary directory (say C:\CTEMP) into the box labeled "Unzip to folder" and then click the "Run WinZip" button. Once the files are extracted, click "CLOSE" to close the dialog box.

With Windows Explorer, navigate to the temporary directory that you just established. Find the "SETUP.EXE" file and double click it. This will execute the CONSUME installation routine. Follow the instructions to complete the installation of CONSUME 2.1.

Once CONSUME 2.1 is installed, a CONSUME 2.1 icon will appear on your desktop and a "USFS Consume" program group will be accessible from the Windows Start\Programs menu.

Incidentally, SIS does not use the CONSUME 2.1 icons, executables, or database files. SIS has its own database file and only uses the CONSUME 2.1 pile wizard dynamic link library (dll) file.

WARNING: If you are using Windows 2000, NT, or XP, you need to be logged in with administrator rights to install CONSUME 2.1 (either as the administrator, or as a user with administrator rights). If you do not have administrator rights, CONSUME 2.1 may not install properly. To get administrator rights, see your Systems Administrator.

ADDITIONAL WARNING: We have observed that some computers using the Windows 2000 operating system experience difficulties in installing or running the CONSUME 2.1 dynamic link library file. If you are experiencing problems, see the section labeled "Additional Help" below.

Microsoft Excel Considerations

SIS uses Microsoft Excel as the graphic user interface, so you must have Microsoft Excel installed on your computer. In addition, Excel must be set to either "Medium" or "Low" security in order to run properly. A High security level will disable SIS.

To set the security level in Microsoft Excel, first open Excel and select "Tools" from the main menu bar. Under "Tools," select "Macros," and then "Security." A dialog box will appear. Select the "Security Level" tab, click the "Medium" level, and then click "OK". Close Excel.

Additional Help

If you experience any trouble in loading or operating SIS, please refer to Appendix A for a description of some common mistakes that are made, and their solution.

If you continue to have trouble installing or running SIS, please contact Mr. Trent Wickman, Air Quality Specialist, USDA Forest Service, Superior National Forest, Duluth, MN, (218) 626-4372, or you may email him at: twickman@fs.fed.us.

RUNNING SIS

Understanding the SIS Model Architecture

SIS contains three main folder types:

- SIS Main Folder
- Project Folders (multiple folders are possible; a default Project folder--DEMO--comes with SIS)
- Exec Folder (one only)

Each of these folder types is described below.

Main SIS Folder

The SIS folder structure is shown in the following screen capture.

| | | | |
|----------------|----------|------------------------|-----------------|
| DEM0 | | File Folder | 3/10/2003 10:30 |
| Exec | | File Folder | 3/10/2003 10:30 |
| Consume.mdb | 1,310 KB | Microsoft Access Ap... | 3/27/2003 2:22 |
| SISmodel_2.xls | 2,941 KB | Microsoft Excel Wor... | 3/28/2003 10:18 |
| SISsetup.txt | 4 KB | Text Document | 4/1/2003 11:17 |

The “**DEMO**” folder in this screen capture is a Project folder. The next section describes the contents of Project folders.

The “**Exec**” folder contains the SIS executable programs.

“**Consume.mdb**” is a Microsoft Access database file for CONSUME 2.1 that is used only by SIS. It cannot be used by CONSUME 2.1. This file must reside in the in the same location as the SIS model. The SIS model will not work if this file is moved elsewhere.

“**SISmodel_2.xls**” is a Microsoft Excel workbook that is the SIS model. The Excel program serves as the graphic user interface. Embedded macros run all of the component processes in SIS. The SIS model will not work if this file is moved elsewhere.

“**SISsetup.txt**” is a text file with setup instructions. This file *may* be moved elsewhere without affecting the model.

Project Folders

Project folders are collections of scenarios that are contained in subfolders. The subfolders, which are given the same name as the scenario, contain all of the scenario inputs and outputs. Project

folders and scenario subfolders can be given any name as long as they are limited to 8 characters with no spaces.

The DEMO folder shown in the above screen capture is a Project folder that contains the input and output files for a demonstration project. The DEMO project that comes with SIS contains three scenarios (subfolders, click on the DEMO to reveal the subfolders):

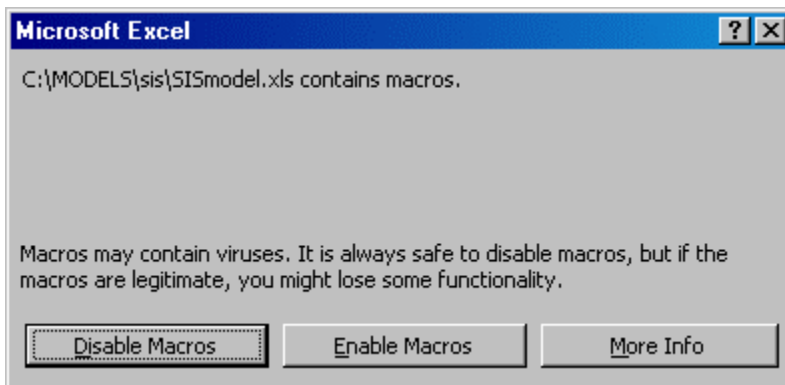
- Scenario named "BB" (set of demonstration input and output files for a broadcast burn unit)
- Scenario called "Wildfire" (set of demonstration input and output files for a wildfire)
- Scenario named "Pile" (a set of demonstration input and output files for a pile burn unit)

EXEC Folder

The EXEC folder contains all of the executable programs that SIS uses, including the CALPUFF model.

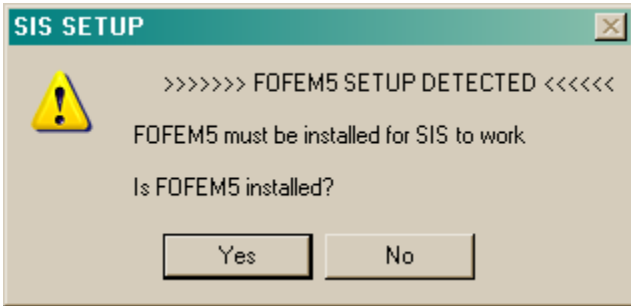
Starting Up the Model

To start up SIS, navigate to the working folder and click twice on the file named "SISmodel_2.xls". If Excel's security level has been properly set to Medium, the following window will appear. If it doesn't appear, try resetting the security level according to the instructions in Chapter 2, Installing SIS, Microsoft Excel Considerations, 2nd paragraph.

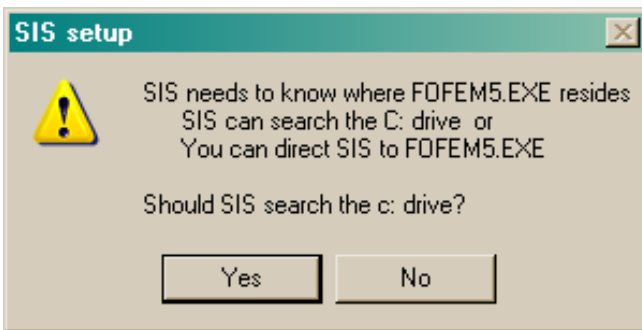


To continue past this point, ALWAYS click on the "Enable Macros" command button (middle button). In Microsoft Excel, there is no simple way to automate the enabling of macros without lowering the security level beyond a reasonable limit, so the user is asked to deliberately choose this option.

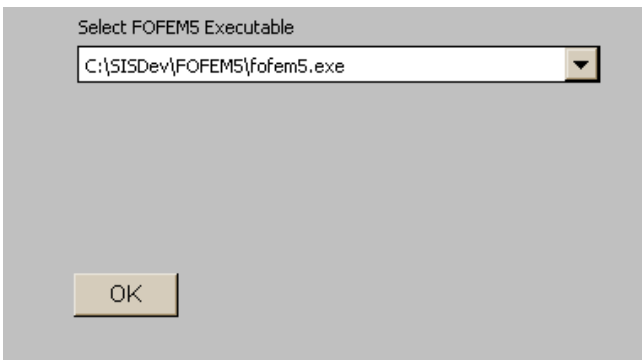
The first time SIS is started, SIS will ask for assistance in locating the FOFEM5 executable file by displaying a series of dialog boxes. The first dialog box to appear will prompt the user to verify that FOFEM5 was installed.



Click "Yes" if FOFEM5 has been installed. If "No" is selected, then SIS will close automatically to allow the to install FOFEM5. If "Yes" is selected, then a second dialog box appears:

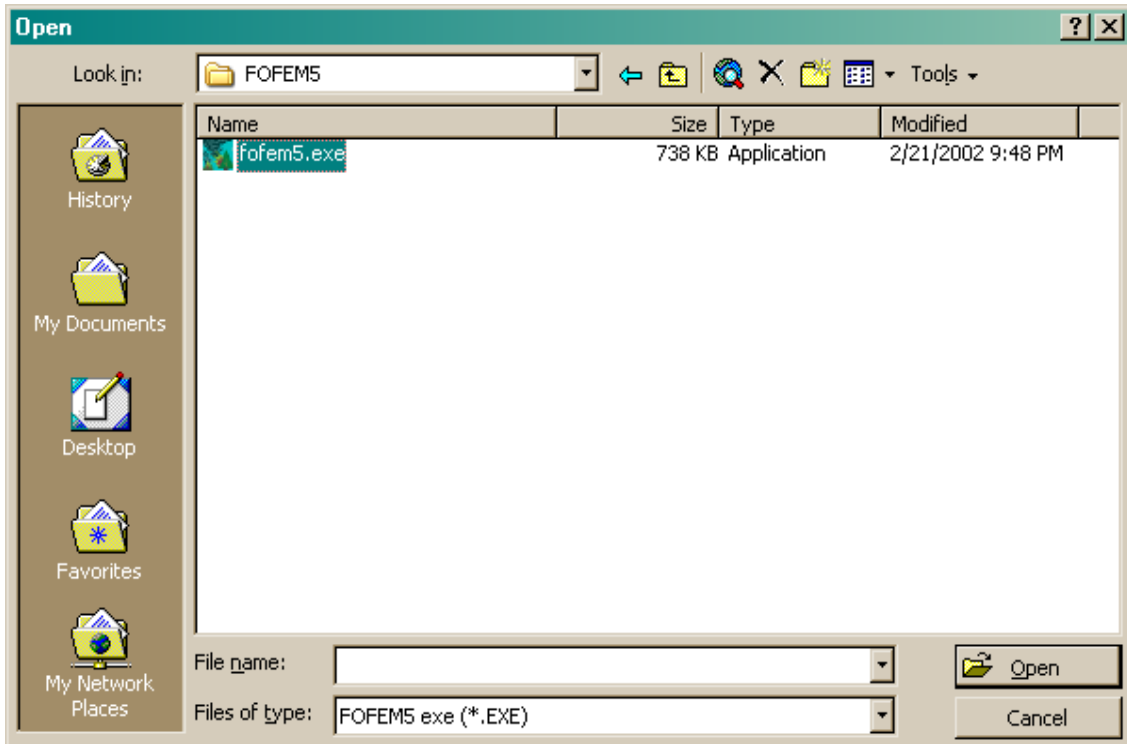


SIS needs to know where FOFEM5 resides. The user has two options: (1) SIS will search the C:\ drive for FOFEM5, or (2) the user can manually direct SIS to the location of the FOFEM5 executable file. If the user selects "Yes", then SIS will search the computers "C:\ drive for FOFEM5. If one instance of FOFEM5 is found, SIS makes the link and completes the startup. If no instances of FOFEM5 are found, the user is notified and SIS closes. If more than one instance of FOFEM5 is found, the following dialog box is displayed:



From the drop-down list, select the FOFEM5 executable file that you wish to use and then click “OK” to establish the link.

The user may choose to establish this link directly by clicking “No” on the second SIS setup dialog box. In this case, the following file browser window will appear:



Using the internet browser (Netscape or Explorer, for example), navigate to find the FOFEM5.EXE file (may be shown in lower case, fofem5.exe), highlight it, and then click the “Open” button to establish the link.

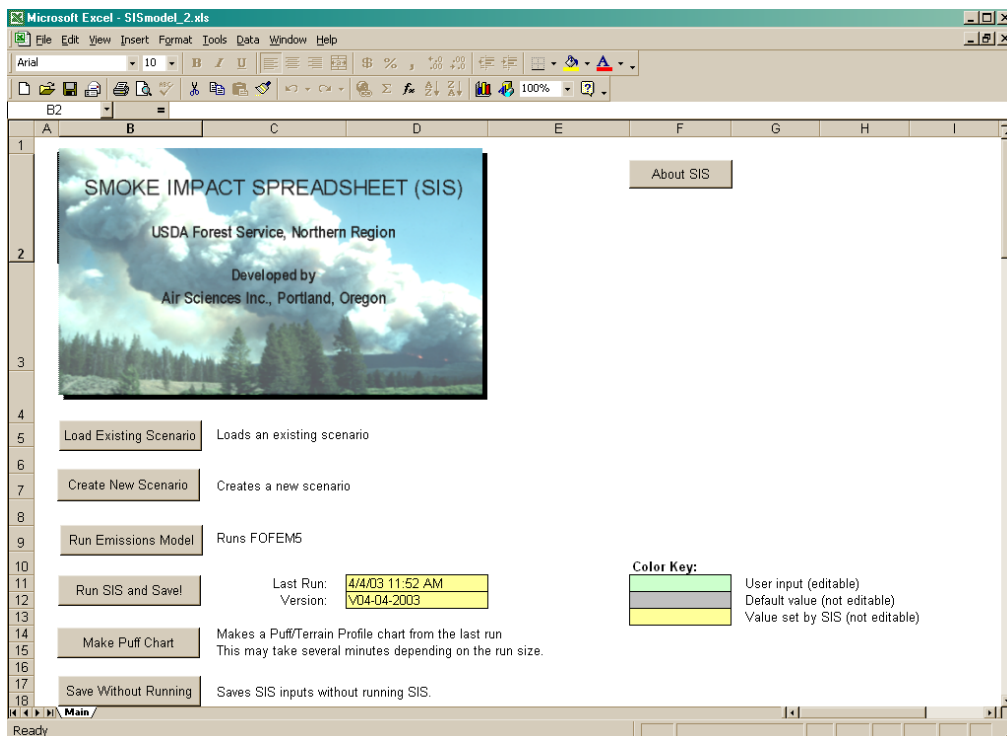
Note: If your version of FOFEM5 resides on a network drive (mapped with a letter), you can manually link to that FOFEM5 executable.

Once the FOFEM5 link is established and the SIS workbook is saved, SIS will know where FOFEM5 resides. On subsequent startups, SIS just verifies that the FOFEM5 link is valid and skips the FOFEM5 screens.

Note: SIS places the FOFEM5 link on the **Main** worksheet. If a user wants to use another instance of FOFEM5, they can replace the existing FOFEM5 filename with a new one. If the user wishes to use the FOFEM5 setup dialog boxes, the user should clear the FOFEM5 link from the **Main** worksheet, save the SIS workbook, exit, and then restart SIS. SIS will then execute the FOFEM5 setup routine.

Note: If the FOFEM5 directory is moved or renamed, SIS will be unable to verify the FOFEM5 link, and the FOFEM5 setup routine will be executed the next time SIS is started up.

After the startup has been completed, the main program worksheet will appear (see picture below). The version number of the model can be found by clicking the “About SIS” button to the right of the main picture (top center). The version number will change each time a new version of the model is released. To find out the latest release of SIS, contact Mr. Trent Wickman, Air Quality Specialist, USDA Forest Service, Superior National Forest, Duluth, MN, (218) 626-4372, or you may email him at: twickman@fs.fed.us.



Inside SIS—Understanding the Spreadsheet Architecture

As soon as SIS is started up, the **Main** worksheet is displayed. The **Main** worksheet is the primary sheet used in specifying the inputs and executing the various models. The SIS **Main** worksheet is

composed of six command buttons and six input groups (which are described later). The six command buttons are:

- Load Existing Scenario
- Create New Scenario
- Run Emissions Model
- Run SIS and Save
- Make Puff Chart
- Save Without Running

The operations of each button are described below.

“Load Existing Scenario” Command Button

The “Load Existing Scenario” command button allows the user to navigate to a previously created SIS project and scenario. Pressing this command button will display a form for the user to select the desired project/scenario combination. The user can select one of the scenarios listed in the list box (there may be more than one). When a scenario is selected, the scenario description is shown in the text box immediately below the list box. To load the scenario, select the desired scenario and then click the “OK” button. You can cancel the load process and return to the main sheet by clicking the “Cancel” button. If the “Display Outputs” box, which is located above the scenario list box, is checked when the “OK” button is selected, SIS will load the scenario inputs onto the **Main** worksheet and recreate the output sheets (**Run Inputs, Emissions Table, Concentrations Table, Charts, and Emissions Model**). If the “Display Outputs” box is not checked, then SIS will load the existing scenario inputs and display the **Emissions Model** sheet only.

Note: When SIS opens an existing scenario, it checks the SIS and emissions model input records and alerts the user if certain inconsistencies are found. Inconsistencies can occur if the user fails to save the files either at the SIS worksheet level or at the emissions model level.

“Create New Scenario” Command Button

The “Create New Scenario” command button allows the user to create a new SIS project and scenario, or to create a new scenario within an existing project. Pressing this command button will display a form for the user to select the desired project and scenario combination. An example of the New Scenario form is shown below. First, the user selects the type of burn using the top-most list box. The user can select either a broadcast burn, a wildfire, or a pile burn. The treatment of each of these fire types is described later.

Next, the user can select whether to use the values currently on the **Main** worksheet or to replace the values with default values. In most cases, it is recommended that the existing sheet values be used.

Next, the user can place the new scenario in a *new project folder* or in an *existing project folder*. If you are putting the new scenario in an existing project folder, click the “Use Existing Project” button and then select the project name from the options in the list box. If you are putting the new scenario in a new project folder, click the “Make New Project” button and then enter the new project name in the box just below the button. The new project name can be any length but cannot contain any spaces. You can edit the text in the box by double clicking the box.

The new scenario name is placed in the bottom box. The scenario name can be any length but cannot contain any spaces.

Note: The user is advised to avoid using non-alphanumeric characters (e.g., “~!@#\$\$%^&*) in the Project or Scenario names.

Note: When you are finished editing the Scenario or Project names, you may need to click the mouse on an empty portion of the form to exit out of Edit mode. The form buttons cannot be executed while in Edit mode.

You can cancel the process and return to the **Main** worksheet by clicking the “Cancel” button. When the “OK” button is clicked, SIS will create the new scenario folders and inform the user about the folder created. When this module is run, SIS only creates the scenario folders but will not create any input files.

Operating Hints: If you are simulating a broadcast burn or wildfire and wish to use the same FOFEM5 input files for both fire types (contained in separate scenarios), you can manually copy an existing FOFEM5 input file (SIS.prj) into the new scenario folder. SIS will read this file rather than create a new SIS.prj file. If you are simulating a pile burn and wish to use the same pile types in each of several scenarios, you can manually copy an existing Pile input file (PILE.INP) into the new scenario folder. SIS will read this file rather than create a new PILE.INP file.

“Run Emissions Model” Command Button

Once an existing scenario is loaded or a new scenario has been created, the user can modify the inputs on the **Main** worksheet. A description of the inputs is provided later. Once the inputs are

properly entered, the user begins the modeling process by clicking the “Run Emissions Model” command button. The emissions model that will be used—FOFEM5 for broadcast burns and wildfire, and the CONSUME 2.1 pile wizard for pile burns—is identified in the text box to the right of the button.

FOFEM5

After clicking the “Run Emissions Model” but before launching FOFEM5, SIS displays a dialog box that reminds the user to save files before ending the FOFEM5 session. Once the user clicks the “OK” button on the dialog box, SIS launches FOFEM5 and the FOFEM5 model startup screen appears next, followed by the input form. The user may then enter data for the scenario being considered.

Appendix B contains a description of the FOFEM5 model, as well as some limited guidance for operating the model. The information presented in Appendix B is from the course materials for a smoke emissions and dispersion modeling short course presented in Sacramento in March 1999 for the USDA Forest Service. A Help system is also available by clicking on the Help menu item inside FOFEM5.

Following are some ideas for realistic smoke modeling using FOFEM5 provided by Bob Hammer, USDA Forest Service, Bitterroot National Forest (Montana), and based on discussions with forest fire and fuel experts Chuck Stanich, Tobin Kelley, Dewey Arnold, and FOFEM5 model creator and Research Ecologist, Bob Keane. As more fuel experts and smoke modelers use FOFEM5, further adjustment of the input parameters will be made to improve model realism. Following is a suggested table of 10-hour, 1000-hour, and duff moisture contents by burn type:

Table 3-1: Suggested fuel moisture contents by fire type and season of burn

| Burn Type and Season | 10-Hour Fuel Moisture Content (%) | 1000-Hour Fuel Moisture Content (%) | Duff Moisture Content (%) |
|------------------------|---|---|------------------------------|
| Spring Prescribed Fire | 14 | 20 | 175 |
| Typical-Year Wildfire | 6 | 15 | 150 |
| Drought-Year Wildfire | 4 | 10 | 50 |
| Fall Prescribed Fire | 10 | 20 | 100 |

The new FOFEM5 users guide should be consulted for additional ideas on creating a realistic modeling scenario. Clicking on “Help” on the FOFEM5 input window will bring up the users guide with a variety of tips and references.

Once the inputs are properly entered, three FOFEM5 files need to be saved.

The steps for properly executing FOFEM5 are as follows:

1. Select the "Smoke" option radio button (round-dot button)
2. *Create a report:* Click "Report" on the menu bar, then click on "Create Report". As an alternative, just press the "Ctrl" and "R" keys at the same time (^R). The report will be displayed in the lower part of the FOFEM5 window.
3. *Save Report to file:* Click "Report" on the menu bar, then click on "Save Report to File". A "save Report file as..." dialog box will appear. At this point, just click "Save". Do not change the filename or the folder.
4. *Save Burnup Emissions file:* Click "Options" on the menu bar, then click on "Save BurnUp Emissions File". A "save Emission file as..." dialog box will appear. At this point, just click "Save". Do not change the filename or the folder.
5. *Save the project file:* Click "Project" on the menu bar and then click "Save". A "Save Project..." dialog box will appear. At this point, just click "Save". Do not change the filename or the folder.

WARNING: It is important to save all three FOFEM5 files. Otherwise, inconsistencies between the inputs and outputs will occur.

Once these files are saved, close FOFEM5 and then click on the "OK" in the SIS dialog box.

Note: Remember to close FOFEM5 before continuing with SIS.

When the SIS "OK" button is clicked, a listing of the emissions model inputs and a copy of the report file are placed on the worksheet entitled "**Emissions Model**". The user should review this sheet to verify the emissions characterization is correct. An example of a FOFEM5 **Emissions Model** sheet is shown below.

| Smoke Impact Spreadsheet (SIS) Model Emissions settings | | | | | | | | | | | | | | | |
|---|---|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| 1 | Smoke Impact Spreadsheet (SIS) Model Emissions settings | | | | | | | | | | | | | | |
| 2 | Scenario: C:\SIS\DEMO\Wildfire | | | | | | | | | | | | | | |
| 3 | Emissions Model: FOFEM5 | | | | | | | | | | | | | | |
| 4 | File Date: 3/14/2003 9:39:02 AM FOFEM5 Report File | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | |
| 6 | #Mortality = NO | | | | | | | | | | | | | | |
| 7 | #Fuel = NO | | | | | | | | | | | | | | |
| 8 | #Smoke = YES | | | | | | | | | | | | | | |
| 9 | #Soil = NO | | | | | | | | | | | | | | |
| 10 | #Region = Interior_West | | | | | | | | | | | | | | |
| 11 | #Cover-Id = SAF/SRM | | | | | | | | | | | | | | |
| 12 | #Fire-Sev = Moderate | | | | | | | | | | | | | | |
| 13 | #Cover-Type = SAF 016 - Aspen | | | | | | | | | | | | | | |
| 14 | #Season = Spring | | | | | | | | | | | | | | |
| 15 | #Moisture = Moderate | | | | | | | | | | | | | | |
| 16 | #Category = Natural-Fuel | | | | | | | | | | | | | | |
| 17 | #TPA-Lit = 0.90 | | | | | | | | | | | | | | |
| 18 | #TPA-W0 = 0.20 | | | | | | | | | | | | | | |
| 19 | #TPA-W01 = 1.20 | | | | | | | | | | | | | | |
| 20 | #TPA-W13 = 1.50 | | | | | | | | | | | | | | |
| 21 | #TPA-W3 = 6.00 | | | | | | | | | | | | | | |
| 22 | #TPA-Duf = 7.50 | | | | | | | | | | | | | | |
| 23 | #TPA-Her = 0.30 | | | | | | | | | | | | | | |
| 24 | #TPA-Shr = 0.50 | | | | | | | | | | | | | | |
| 25 | #TPA-CrF = 0.00 | | | | | | | | | | | | | | |
| 26 | #TPA-CrB = 0.00 | | | | | | | | | | | | | | |
| 27 | #TPAc-Lit = Typical | | | | | | | | | | | | | | |
| 28 | #TPAc-W0 = Typical | | | | | | | | | | | | | | |
| 29 | #TPAc-W01 = Heavy | | | | | | | | | | | | | | |
| 30 | #TPAc-W13 = Heavy | | | | | | | | | | | | | | |
| 31 | #TPAc-W3 = Heavy | | | | | | | | | | | | | | |
| 32 | #TPAc-Duf = Heavy | | | | | | | | | | | | | | |
| 33 | #TPAc-Her = Typical | | | | | | | | | | | | | | |
| 34 | #TPAc-Shr = Typical | | | | | | | | | | | | | | |

| FUEL CONSUMPTION TABLE | | | | | | |
|------------------------|--------------|---------------|---------------|-----------------|--------------------|----------|
| Fuel | Preburn Load | Consumed Load | Postburn Load | Percent Reduced | Equation Reference | Moisture |
| Name | (t/acre) | (t/acre) | (t/acre) | (%) | Number | (%) |
| Litter | 0.90 | 0.90 | 0.00 | 100.0 | 999 | |
| Wood (0-1/4 inch) | 0.20 | 0.20 | 0.00 | 100.0 | 999 | |
| Wood (1/4-1 inch) | 1.20 + | 1.20 | 0.00 | 100.0 | 999 | 25.0 |
| Wood (1-3 inch) | 1.50 + | 1.02 | 0.48 | 68.1 | 999 | |
| Wood (3+ inch) Sound | 5.40 + | 0.79 | 4.61 | 14.5 | 999 | 20.0 |
| 3->6 | 1.35 | 0.40 | 0.95 | 30.0 | | |
| 6->9 | 1.35 | 0.22 | 1.13 | 16.0 | | |
| 9->20 | 1.35 | 0.12 | 1.23 | 8.6 | | |
| 20-> | 1.35 | 0.05 | 1.30 | 3.7 | | |
| Wood (3+ inch) Rotten | 0.60 + | 0.17 | 0.43 | 28.9 | 999 | 20.0 |
| 3->6 | 0.15 | 0.08 | 0.07 | 56.1 | | |
| 6->9 | 0.15 | 0.05 | 0.10 | 32.3 | | |
| 9->20 | 0.15 | 0.03 | 0.12 | 18.7 | | |
| 20-> | 0.15 | 0.01 | 0.14 | 8.5 | | |
| Duff | 7.50 + | 3.08 | 4.42 | 41.1 | 2 | 100.0 |
| Herbaceous | 0.30 | 0.30 | 0.00 | 100.0 | 22 | |
| Shrubs | 0.50 | 0.30 | 0.20 | 60.0 | 23 | |

The first four lines are header lines that provide the run and model information, including the scenario name, and stamp of the FOFEM5 input files. Column A displays the FOFEM5 input parameters used in the run. Column C shows a copy of the report file.

Note: If the report file is not saved, SIS will not list the report file.

CONSUME 2.1 Pile Wizard

For pile burn scenarios, SIS will launch the CONSUME 2.1 pile wizard when the "Run Emissions Model" command button is clicked. The pile wizard window is shown below.

The pile wizard allows the user to create and edit numerous pile types, define their characteristics, and enter the number of piles by pile type. Although any number of pile types can be defined in the Pile Wizard, SIS limits the user to 10 pile types per scenario.

Existing Pile Group Information

Pile Group Name: USFSCAX Version : 2.1 rev. 146

Pile Dimensions and Quality | Packing Ratio | Other Details

Pile Shape

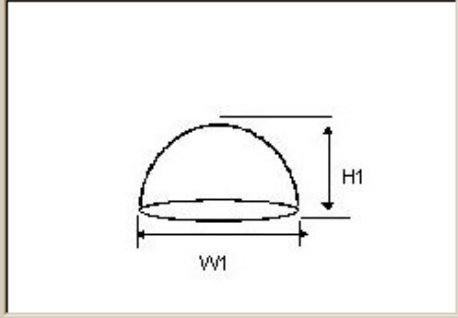
- Half-section sphere
- Paraboloids
- Half-cylinder
- Half-frustum of cone
- Cone with round ends
- Half-ellipsoid
- Irregular solid

Pile Dimensions (ft)

Width 1:

Height 1:

Pile Shape Drawing (Click on picture to view options)



Valid

Each pile type must have at least one pile before the type will be considered valid. Unwanted pile types must be deleted before proceeding.

For more information on the CONSUME 2.1 Pile Wizard, please refer to the CONSUME 2.1 documentation. A user's guide may be downloaded from the Fire and Environmental Applications Research Team (FERA)'s web site at:

<http://www.fs.fed.us/pnw/fera/products/consume.html>

When you have properly entered the pile information, the status tab below the "Finish" button should say "Valid." When the "Finish" button is clicked, the wizard closes and SIS creates the emissions output files, transfers some pile information to the **Main** worksheet and summarizes the emissions information in the **Emissions Model** worksheet. An example of the **Emissions Model** worksheet is shown below.

The first five lines are header lines that provide the run and model information, including the scenario name, Pile wizard version number, and the run date. The remaining sheet shows each of the pile types and their characteristics for the scenario.

| Name | SISPILE | Wallpile |
|-------------------|---------------------|----------------|
| PileType | Half section sphere | Half cylinder |
| Width1 | 100 | 100 |
| Height1 | 10 | 20 |
| Length1 | 0 | 200 |
| Width2 | 0 | 0 |
| Height2 | 0 | 0 |
| Length2 | 0 | 0 |
| PackRatio | 20 | 10 |
| PileSoil | 0 | 20 |
| PrimarySpecies | Sitka spruce | Ponderosa pine |
| PS1Percent | 70 | 80 |
| Density1 | 23.10000038 | 23.70000076 |
| PrimarySpecies2 | True fir | Quaking aspen |
| PS2Percent | 30 | 20 |
| Density2 | 23.10000038 | 21.89999962 |
| PileQuality | 1 | 1 |
| NumberPiles | 1 | 1 |
| VolumePerPile | 52360 | 314159 |
| MassPerPile | 241903 | 586598 |
| TotalMassConsumed | 217712 | 527938 |
| IsValid | TRUE | TRUE |

“Run SIS and Save!” Command Button

Press the “Run SIS and Save!” button only after all of the other inputs described below have been properly entered. Clicking this button (1) executes the CALPUFF model using the emission rates generated using either the CONSUME 2.1 pile wizard or the FOFEM5 model, and (2) saves the **Main** worksheet inputs to disk.

If the scenario has been run previously, SIS will ask whether you want to overwrite the files. If “yes,” SIS runs the CALPUFF model and displays a dialog box when the run is complete.

Note: SIS displays a dialog box that gives the user the option (“No”) to skip CALPUFF and proceed directly with displaying the options. This option is intended for debugging purposes only. It is recommended that the user always chose “Yes” to run CALPUFF.

When CALPUFF is finished executing, SIS displays the run outputs on four sheets:

- Run Inputs
- Emissions Table

- Concentration Table
- Emissions and Concentration Charts

Each of these worksheets is described below.

Run Inputs

An example Run Inputs worksheet is shown in the screen capture (partial) below. The inputs in this group are exactly those shown in the **Main** form that was previously described. The header information contains the SIS model version and the run date and time.

| Smoke Impact Spreadsheet (SIS) Model Inputs | | | |
|---|--------|------------------------------|--------|
| Scenario: C:\SIS\DEMO\BB | | | |
| SIS version V03-27-2003 | | | |
| Run 3/27/2003 11:50:16 AM | | | |
| Scenario Group | | Model Inputs | |
| Run Description | | Demonstration of a Broadcast | |
| Burn type | | Burn run | |
| Emissions model | | BROADCAST BURN | |
| | | FOFEM5 | |
| Burn Group | | | |
| Fuel Model | | 1 - Heavy Slash | |
| Maximum spread component (ft/min) | | DEFAULT | |
| Fire rate as percent of max spread comp. | | DEFAULT | |
| Source interval (minutes) | | 20 | |
| FOFEM5 report file | | report.txt | |
| FOFEM5 BURNUP file | | emission.txt | |
| Subunit Description | | | |
| Subunit | 1 | 2 | 3 |
| Area (acres) | 100 | 10 | 15 |
| Starting hour | 10 | 11 | 12 |
| Width (ft) | SQUARE | SQUARE | SQUARE |
| Length (ft) | 2087.1 | 660 | 808.33 |
| # of strips | 5 | 2 | 3 |
| Strip spacing (ft) | 417.42 | 330 | 269.44 |
| Ignition rate (ft/min) | 180 | 180 | 180 |
| Ignition time (hours) | 1.12 | 0.15 | 0.27 |
| Meteorological Group | | | |
| Burn Month | 7 | | |

Emissions Table

An example of the Emissions Table worksheet is shown in the screen capture below. Note that the header information contains the scenario name, the emissions model used in the run scenario (either FOFEM5 or CONSUME 2.1), the SIS version number, and the run date and time.

| Hour | Emissions (kilograms) | Heat Released (Joules) |
|------|-----------------------|------------------------|
| 1 | 0 | 0 |
| 2 | 0 | 0 |
| 3 | 0 | 0 |
| 4 | 0 | 0 |
| 5 | 0 | 0 |
| 6 | 0 | 0 |
| 7 | 0 | 0 |
| 8 | 0 | 0 |
| 9 | 0 | 0 |
| 10 | 103228.0531 | 3.35986E+14 |
| 11 | 110671.0638 | 2.08787E+14 |
| 12 | 80964.80954 | 1.12544E+14 |
| 13 | 34324.9339 | 1.4326E+13 |
| 14 | 15887.27445 | 5.63488E+12 |
| 15 | 6534.551896 | 2.33296E+12 |
| 16 | 3475.465112 | 1.22647E+12 |
| 17 | 2334.097527 | 8.21732E+11 |
| 18 | 1657.366622 | 5.83617E+11 |
| 19 | 943.8178662 | 3.49902E+11 |
| 20 | 239.0013089 | 1.00539E+11 |
| 21 | 43.34183676 | 18193596349 |
| 22 | 0 | 0 |
| 23 | 0 | 0 |
| 24 | 0 | 0 |

Concentration Table

An example of the **Concentration Table** worksheet is shown in the screen capture below. The header information contains the scenario name, the emissions model used in the run scenario (either FOFEM5 or CONSUME 2.1), the SIS version number, and the run date and time.

This table also identifies the amount of plume mass that lies *above* the mixing height (row 6 in the example spreadsheet).

| Downwind Distance from Burn Unit (miles) | 24-Hour Average PM _{2.5} Concentration (µg/m ³) |
|--|--|
| 0.1 | 393.28 |
| 0.2 | 303.49 |
| 0.3 | 251.08 |
| 0.4 | 215.18 |
| 0.5 | 188.44 |
| 0.6 | 167.68 |
| 0.7 | 151.4 |
| 0.8 | 137.92 |
| 0.9 | 126.54 |
| 1 | 116.96 |
| 1.1 | 108.83 |
| 1.2 | 101.79 |
| 1.3 | 95.731 |
| 1.4 | 90.441 |
| 1.5 | 85.796 |
| 1.6 | 81.685 |
| 1.7 | 77.986 |
| 1.8 | 74.625 |
| 1.9 | 71.574 |
| 2 | 68.789 |
| 2.1 | 66.141 |
| 2.2 | 63.727 |

Emissions and Concentration Charts

An example of the **Charts** worksheet is shown on the next page. The first chart is a plot of PM_{2.5} emissions over time, beginning at midnight of the first day of the burn and continuing until the burn is extinguished (that is, when heat production drops below 1 kW/m²). The second chart shows the 24-hour average PM_{2.5} concentration as a function of downwind distance (out to the maximum distance specified, which in this case is 50 miles) with the current 24-hour average PM_{2.5} standard of 65 µg/m³ shown as a dashed red line. To view the data used to build this graph, simply hold the cursor on the blue line for a few seconds and the following tool-tip message will appear:

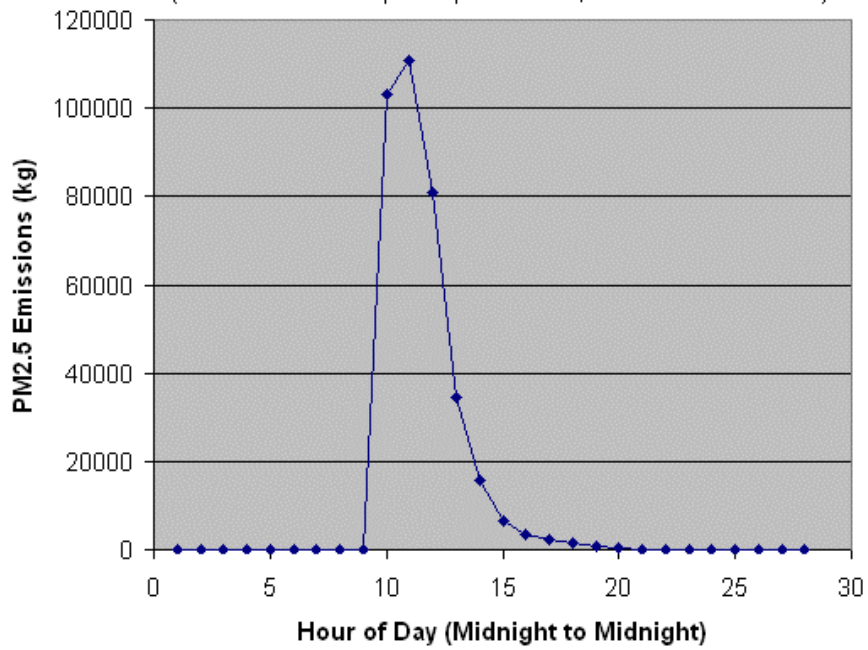
Series "PM_{2.5} Concentration "Point X" (X, Y)

where X is the downwind distance in miles and Y is the PM_{2.5} concentration in µg/m³.

Note: The header information in both charts contains the scenario name and the SIS version number only. The user should refer to either the **Emissions** worksheet or the **Concentrations** worksheet for information on the emissions model used and the run date and time.

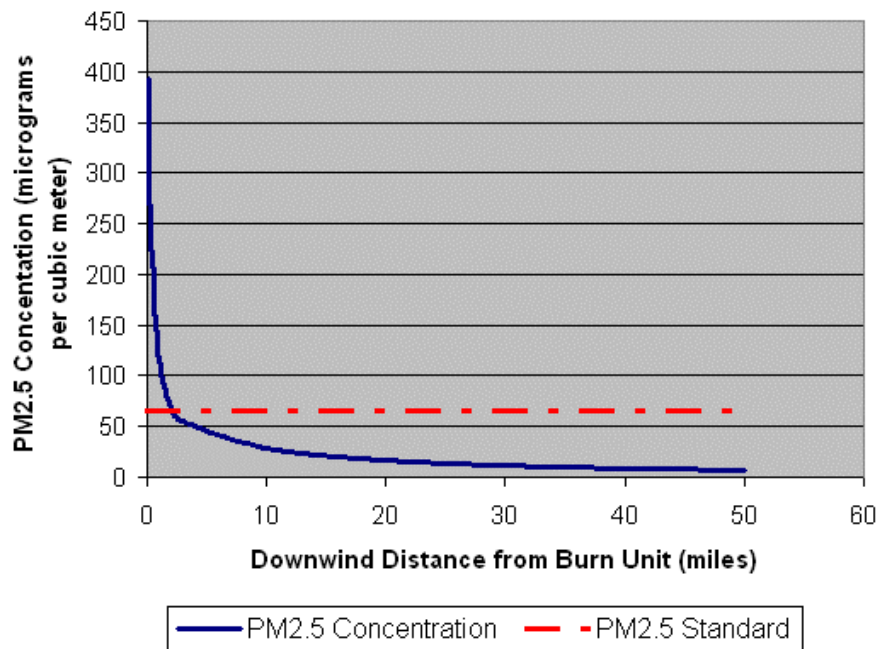
**Times-Series Plot of PM2.5 Emissions
Scenario BB**

(Source: Smoke Impact Spreadsheet, Version V04-04-2003)



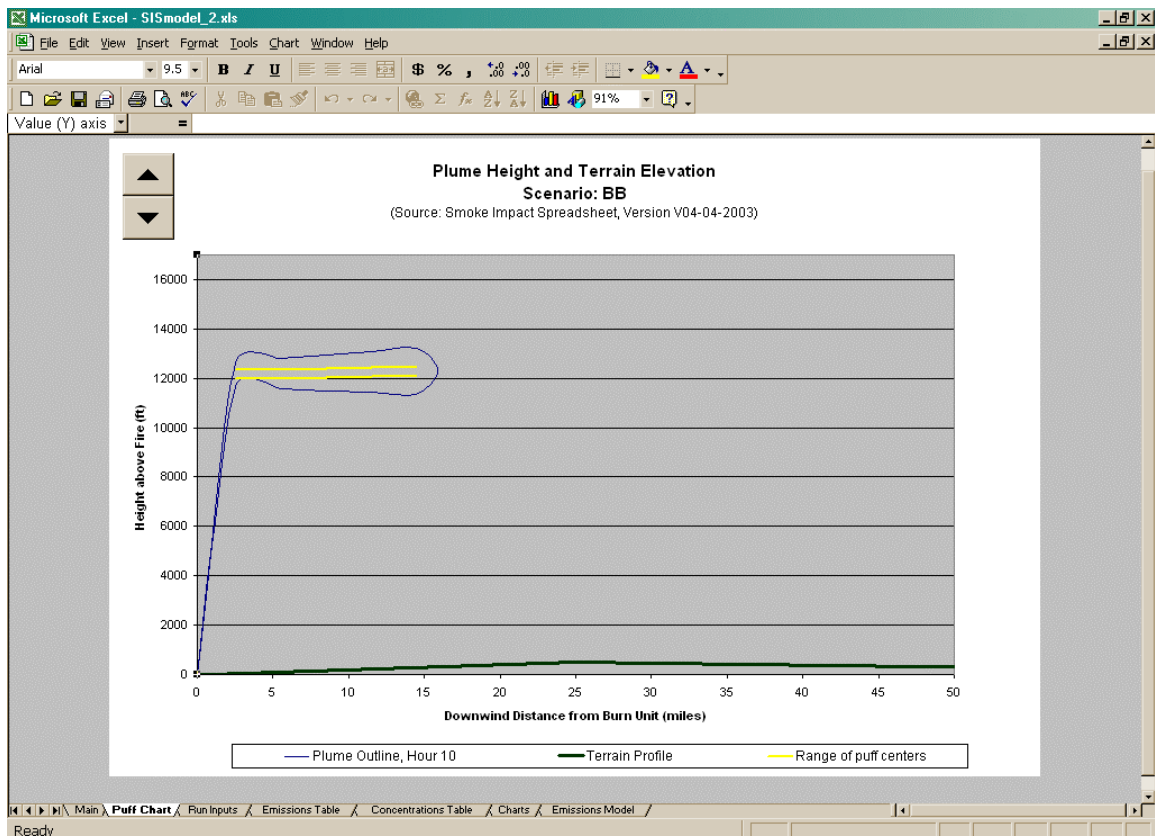
**24-Hour Average 2.5 Concentrations
Scenario BB**

(Source: Smoke Impact Spreadsheet, Version V04-04-2003)



“Make Puff Chart” Command Button

This button makes a **Puff Chart** worksheet from the active run. Depending on the size of the run, the feature can take a few minutes to run. An example of the **Puff Chart** worksheet is shown below. This chart shows the top and bottom of the plume at any downwind distance, with the top measured as the [mean puff centerline + 1 standard deviation] and the bottom measured as the [mean puff centerline – 1 standard deviation]. This particular example shows the plume configuration at the end of hour 10, which is one hour after the start of the fire. The ending hour may be advanced by successively pressing the ▲ in the upper left corner of the screen, and reversed by pressing the ▼ button. The selected hour will be displayed in the legend bar under the graph. The yellow lines represent the upper and lower range of the puff centers. The terrain profile is shown as a dark green line. The y-axis is the elevation above the fire.



Main Worksheet Inputs

To assist the user, cells on the **Main** worksheet are color-coded. Green cells are user input cells, yellow cells are cells SIS will write to and are generally not available for user input and gray cells are default values and cannot be edited. List boxes, which allow the user a list of choices, appear as:

I - Heavy Slash 

The Main worksheet displays seven input groups. They are:

- Scenario Group
- Burn Unit Group
- Broadcast Burn Description
- Wildfire Description
- Pile Burn Group
- Meteorological Group
- Terrain Group

A description of each group follows.

Scenario Group

In this group, the active scenario information is listed (see figure below, including: the working directory name (automatically detected by the model on startup); the scenario pathname and the burn type are listed (either BROADCAST BURN, WILDFIRE, or PILE BURN). The burn type is defined when a scenario is created.

| Scenario Group | | Model Input | User Guidance |
|----------------|------------------------------|---------------------------------------|---|
| 1 | Working directory | C:\SIS | Directory where this model currently resides Display only. |
| 2 | Active project/scenario name | C:\SIS\DEMO\BB | |
| 3 | Burn type | BROADCAST BURN | |
| 4 | Description: | Demonstration of a Broadcast Burn run | Enter or edit active scenario description |

The last entry is the scenario description. The user can edit this description field as they wish. Note that this field is displayed in the “Load Existing Scenario” description.

Burn Group

When the scenario is a broadcast burn or wildfire scenario, the model inputs required in this group (see screen capture below) are used to establish the burn characteristics. The first three entries are used to establish the rate at which the fire moves across the sub units (defined as F) and is given by:

$$F = SCM * (FSF/100) \tag{1}$$

where SCM is the maximum spread component (units of feet per minute), and FSF is fire rate scaling factor expressed as a percent of the SCM. The user must select a National Fire Danger Rating System (NFDRS) fuel model that best describes the modeled fuel bed. For more information on the available NFDRS fuel models and their physical characteristics, please see Cohen and Deeming (1985). For users that are more familiar with the Fire Behavior Prediction System models, Figure 3 of Anderson (1982) presents a crosswalk between the 20 NFDRS fuel models and the 13 fire behavior fuel models.

| Burn Group | Value | |
|---|-----------------------------|---|
| 1 Select NFDRS Fuel Model | I - Heavy Slash | Select one value |
| 2 Enter maximum spread component (ft/min) | DEFAULT 65 | Enter DEFAULT (to use value in gray) or own value (1 to 500 ft/ |
| 3 Enter rate as percent of max spread component | DEFAULT 75 | Enter DEFAULT (to use value in gray) or own value (1 to 100 pe |
| 4 Source Interval (minutes) | 20 (18 sources/hr) | Select one value |
| FOFEM5 executable location | C:\SISDev\FOFEM5\fofem5.exe | |
| 5 FOFEM5 report file name | report.txt | FOFEM5 report (contains output data) |
| 6 FOFEM5 BURNUP emissions file name | emission.txt | BURNUP results used but not displayed |

The user can select this maximum rate of spread default value (shown in the gray cell) by entering "DEFAULT" in the green cell to the right. Or the user can bypass the NFDRS values by entering their own values in the green cell.

For wildfire and broadcast burns, the SIS model was designed to characterize the time evolution of the flaming and smoldering portions of the burn. The CALPUFF dispersion model operates one a one-hour time step, which is too long to resolve the behavior of short burns. Therefore, the SIS model allows the user to characterize the flaming and smoldering portions on a smaller time step, which is defined by the "Source Interval" parameter (line 4). The smallest time step allowed by the model is 3 minutes, which results in 40 sources per hour (20 flaming and 20 smoldering) for each subunit, with each source representing the burn at a 3-minute interval. The coarsest allowable time interval is one hour, which characterizes the burn with one flaming and one smoldering source for each subunit.

The three lines that follow line 4 (blank, 5, and 6) provide information relating to FOFEM5. The blank line immediately following line 4 shows the FOFEM5 executable file location, designated the first time that SIS was started up. If the user wants to open a second instance of FOFEM5, they can replace the existing FOFEM5 filename with a new one. If the user wishes to use the FOFEM5 setup dialog boxes, the user should clear this FOFEM5 link, save and exit the SIS workbook, and then restart SIS. SIS will then execute the FOFEM5 setup routine.

Note: If the FOFEM5 directory is moved or renamed, SIS will be unable to verify the FOFEM5 link and FOFEM5 setup routine will be executed the next time SIS is started up.

Lines 5 and 6 display the FOFEM5 report and BURNUP emissions filenames. FOFEM5 uses default names of “report.txt” for the report file and “emissions.txt” for the BURNUP emissions file. These names are listed as such on the SIS **Main** worksheet. Although the input cells are shown with a yellow background color (indicating that they are SIS-required values), the user can change them if necessary. Regardless, it is strongly advised that the default names be used to ensure that SIS operates correctly.

Broadcast Burn Description

For broadcast burns, the user may distribute the burn unit into a maximum of 10 subunits, each with different start times and ignition characteristics (see form below). The reason for defining subunits is to more accurately reflect the distribution of emissions over time. A subunit may be a different burn unit in a project, or a portion of the lighting sequence.

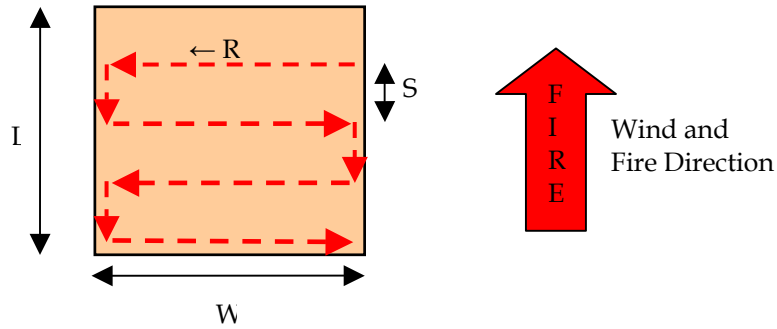
| Broadcast Burn Sub-Unit Description | | | | | | | | |
|-------------------------------------|----------------------------|------------------------------------|---------------|----------------|------------------|-----------------------|-------------------------------|-----------------------|
| | Sub Unit Fire Size (acres) | Starting Hour (1=Midnight to 1 am) | Width, W (ft) | Length, L (ft) | Number of Strips | Strip Spacing, S (ft) | Speed of Ignition, R (ft/min) | Ignition time (hours) |
| 1 | 100 | 10 | SQUARE | 2067.10 | 5 | 417.4 | 180.0 | 1.12 |
| 2 | 10 | 11 | SQUARE | 660.00 | 2 | 330.0 | 180.0 | 0.15 |
| 3 | 15 | 12 | SQUARE | 808.33 | 3 | 269.4 | 180.0 | 0.27 |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |
| 10 | | | | | | | | |

This input description is only available for broadcast burn scenarios. If a pile or wildfire scenario is active, this area will be disabled (that is, grayed out).

To define a subunit, enter the subunit fire size in column 1 of the form. Remember, the total acreage of all the subunits must equal the total burn unit acreage. There is no “total acreage” shown on this form, so the user must manually add up the subunit burn areas.

Next, enter the start time for the ignition of each subunit in column 2. For example, if the ignition begins at 8 am, the start time is entered as 8 (whole numbers only). And if the ignition begins at 2 pm, the start time is entered as 14.

For broadcast burns, the SIS model assumes that the subunit area is rectangular and that the fire is ignited in strips, each with a width of “S”. The strips are lit in a front-to-back pattern (that is, downwind to upwind) at a constant rate of ignition (R) along each line as shown in the diagram.

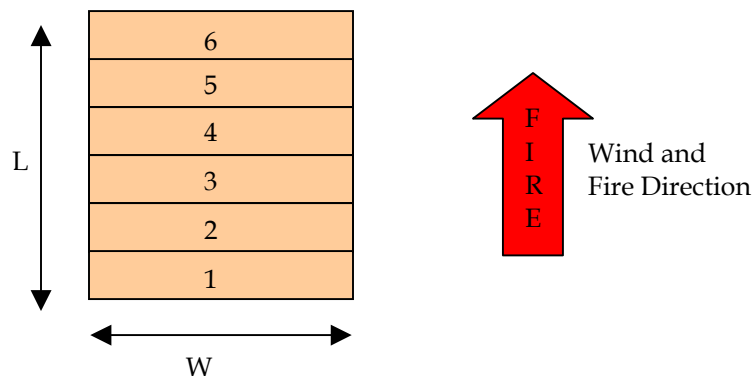


It is assumed that the fire moves downwind at a constant rate, F , based on a user-selected maximum spread component (SCM) and scaling factor (FSF), both of which are specified in the Burn Group, described above. The user specifies the width (the length is calculated from the width), the number of strips between the downwind and upwind edges of the burn unit (from which the strip width S is calculated), and the speed of ignition R . The total time required to light all of the strips (shown in the last column) depends on the number of strips, the width, and the speed of ignition. If the subunit area is square, then the word "SQUARE" may be entered in the width column.

When evaluating broadcast burns, it is important to verify that the *modeled* fire behavior matches that expected for the physical fire. For example, if a prescribed burn is expected to span a period of two days, and SIS indicates the fire will burn out within a couple of hours, then there is a problem either with the modeler's expectations or with the input values. Possible solutions include: re-evaluating the FOFEM5 inputs, decreasing the fire rate F , or increasing the strip spacing to reflect the maximum strip distance.

Wildfire Description

For wildfires, SIS assumes that the area is rectangular and that the fire starts at the farthest upwind edge (strip 1 in the figure below) and moves downwind (toward strip 6) at a constant rate F . For wildfires, only one area is assumed.



The wildfire inputs are specified in the Wildfire Description as shown below:

| Wildfire Description | | | |
|----------------------|---|---------|------------------------------------|
| 1 | Enter wildfire fire size (acres) | 100 | Enter size in acres |
| 2 | Enter starting hour | 10 | Enter hour |
| 3 | Enter width, W (ft) | SQUARE | Enter area width in feet or SQUARE |
| 4 | length, L (ft) | 2087.10 | Calculated length |
| 5 | Time for fire front to cross length L (hours) | 0.47 | Calculated time |

This input form is available for wildfire scenarios only. If the fire is specified as a pile burn or a broadcast burn, then this area will be disabled (grayed out).

In this form, the user enters the fire size (in acres), the starting hour (whole numbers only), and the width of the fire (measured crosswind, in feet). If the wildfire area is square, the user may enter "SQUARE" in the green cell on line 3. SIS will calculate the length (displayed on line 4), and the time that it takes for the fire front to move across the length of the area based on the fire rate F, described above in the Broadcast Burn description.

Pile Burn Group

Pile burn scenarios use the CONSUME 2.1 pile wizard, rather than FOFEM5, for computing emission rates. Consequently, the pile inputs are different from the broadcast burn or wildfire inputs. The characteristics of the pile types are defined in the CONSUME 2.1 pile wizard and not on the SIS input sheet. The pile burn inputs that exist on the SIS **Main** worksheet are shown below.

| Pile Burn Group | | | |
|------------------------------|------------------------------------|--------------------------|--|
| 1 | Number of pile types | 2 | Set in CONSUME PILE WIZARD (max 10 pile types) |
| 2 | Total number of piles | 2 | Set in CONSUME PILE WIZARD |
| 3 | Enter starting hour | 10 | Enter value (1=Midnight to 1 am) |
| 4 | Select pile burn sequence | User specified time | User may select different option for igniting piles. |
| 5 | Wait time between ignitions (min) | 1 | Enter wait time between ignitions in minutes |
| 6 | Select order of pile type ignition | Smallest mass to largest | User may select different options for the order in which piles are |
| Pile Characterization | | | The next two fields allow the user to time-resolve the pile burn. |
| 7 | Number of flaming sources/pile | 1 | The higher the number, the greater the time resolution. |
| 8 | Number of smoldering sources/pile | 3 | Enter value from 1 to 10. |
| | | | Enter value from 1 to 50. |

The first entry is the number of pile types that were defined in the CONSUME 2.1 pile wizard. This parameter is set in the pile wizard and is only echoed on the **Main** worksheet. Although any number of pile types may be defined in the pile wizard, SIS limits the user to 10 pile types per scenario. And even though the user is limited to ten pile types, any number of piles may be modeled. The number of piles in a pile type is also defined in the pile wizard. SIS echoes back the total number of piles that were set in the CONSUME 2.1 pile wizard. In the example shown in the above form, there are two pile types with one pile in each type. This gives a total of two piles (see line 2). Note that each pile type must have a least one pile. Also note that a full description of the CONSUME 2.1 pile wizard output can be found on the **Emissions Model** worksheet.

The starting hour (line 3) represents the hour that the pile ignition begins. Only one to 2-digit whole numbers may be entered here (e.g., 1, 2, 3, ..., 24).

The next three fields define the order in which the piles will be burned. The pile burn sequence parameter (line 4) defines how the piles in a pile type are to be burned. Four options are available:

- All at once
- Start the next pile when flaming ends in the previous pile
- Start the next pile when the previous pile is half burnt
- User specified time

If option 4 is selected, the user-specified wait time between ignitions (in minutes; see line 5) is used.

The third parameter (line 6) specifies the burn order for the pile types. Three options are available:

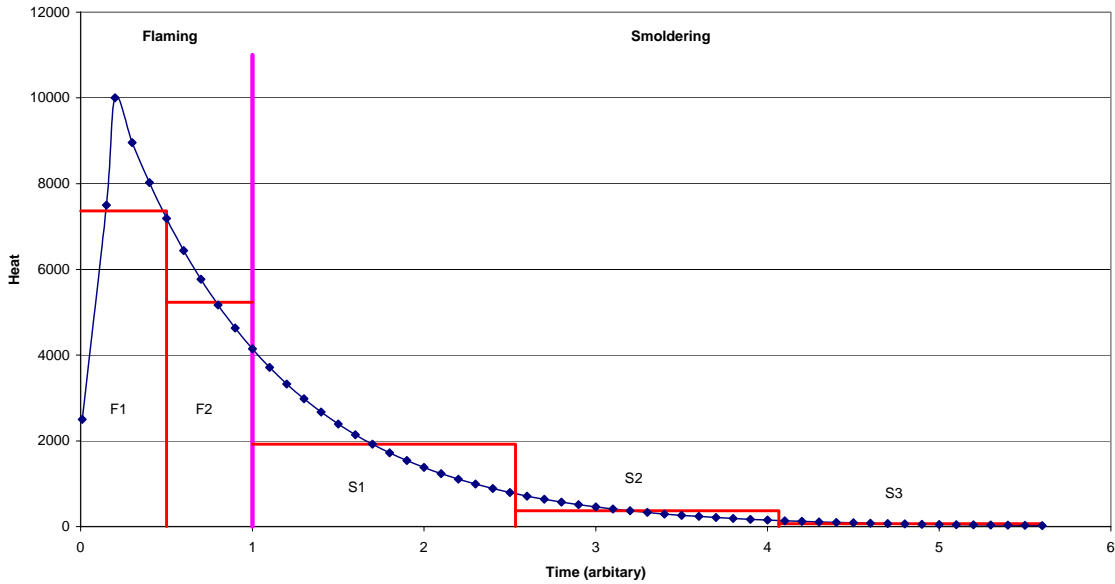
- Burn the smallest-mass pile type first, then move to the larger-mass pile types
- Burn the largest-mass pile type first, then move to smaller-mass pile types
- Start all pile types at same time

When the first two options are selected, the pile types are queued up depending on the pile mass (either largest to smallest, or smallest to largest), on the burn sequence selected, on the pile burn duration, and on the number of piles in the type. Based on this information, SIS figures out the starting hour for each pile type. SIS records this information in a file (called SISBURN.DAT), but does not report this information anywhere in the SIS workbook.

The last two parameters are used to resolve the burn characteristics for the pile burns. Because the potential exists for a large number of piles to be ignited at any time, the potential exists for all phases of pile burning to be active at any time. To avoid averaging out the possible variations, the user can divide the flaming and smoldering phases into smaller, evenly spaced time periods as shown in the below figure.

In this example, the flaming portion is divided into two sources (F1 and F2) representing the first half and second half of the flaming phase. Note that the flaming phase is everything on the left side of the vertical, magenta-colored line. The smoldering portion is divided into three sources (S1, S2 and S3) representing the three periods of the smoldering phase. With this stratification, the SIS model marches through the pile burn sequence for each pile type and builds the composite burn behavior by tallying the heat production and emissions (on a per unit area basis) for each source of the burn that occurs in the hour.

Single Pile Burn Behavior



For pile burns, SIS assumes that the pile footprint is the active burning area. It is assumed that the width (Width 1 on the Pile Wizard form) is in the crosswind direction. For conservatism, all piles are assumed to be co-located.

Meteorological Group

The meteorological inputs are shown in the screen capture that follows:

| Meteorological Group | | | |
|-----------------------------|--|---------------------|--|
| Burn date | | | |
| 1 | Enter burn date: Month | 7 | Enter 1 - 12 (January = 1) |
| 2 | Day | 4 | Enter 1 - 31 |
| 3 | Year | 2003 | Enter 4-digit year |
| 4 | Enter run duration (days) | DEFAULT | Enter whole number or DEFAULT |
| 5 | Enter burn latitude (degrees) | 45 | Enter number |
| Daytime Conditions | | | |
| 6 | Enter daytime 10-meter wind speed (mph) | 5 | Enter number, minimum of 2.2 mph |
| 7 | Enter daytime wind direction offset (degrees) | 0 | Enter 0 to 90 degrees offset angle from line of receptors |
| 8 | Enter daytime maximum temperature (deg F) | 75 | Enter number |
| 9 | Enter daytime Pasquill-Gifford stability class | 2=Slightly Unstable | Select Stability Class |
| 10 | Enter mixing height (feet) | DEFAULT | Enter DEFAULT (to use value in gray) or mixing height above fire |
| Nighttime Conditions | | | |
| 11 | Enter nighttime 10-meter wind speed (mph) | 2.2 | Enter number, minimum of 2.2 mph |
| 12 | Enter nighttime wind direction offset (degrees) | 0 | Enter 0 to 90 degrees offset angle from line of receptors |
| 13 | Enter nighttime minimum temperature (deg F) | 45 | Enter number |
| 14 | Enter nighttime Pasquill-Gifford stability class | 5=Stable | Select Stability Class |

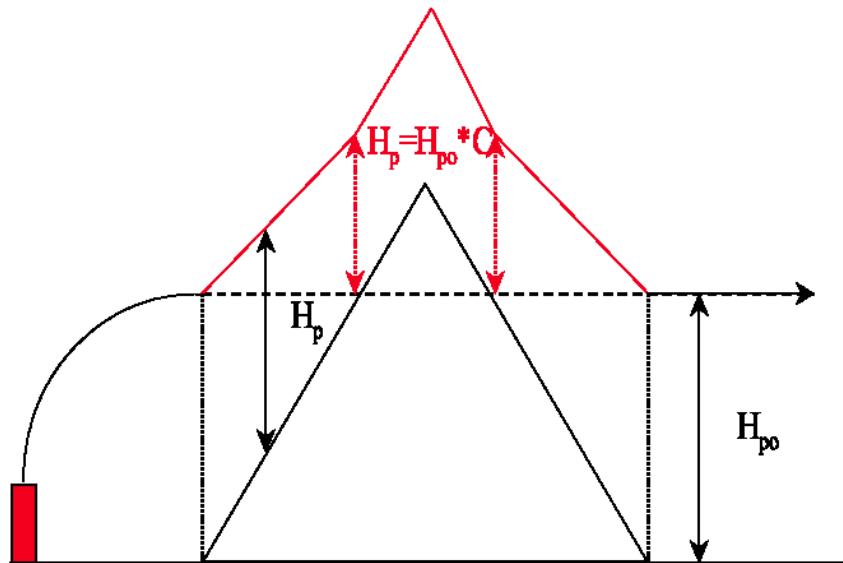
Most of these inputs are self-explanatory and well-understood by fire managers, with the possible exception of the wind-direction offset angle (in degrees) on lines 7 and 12. The SIS model computes the centerline $PM_{2.5}$ concentration assuming that sensitive receptors are located directly downwind of the fire. However, if the sensitive receptors are located away from the centerline of plume travel, then an offset angle ranging from 0 to 90 degrees may be entered. The greater the

wind direction offset angle, the lower the predicted concentration at all downwind distances. Note that the same offset angle must be applied to all receptors. If there are different sensitive receptors with different offset angles, multiple runs of the model will be required, one for each receptor-offset angle combination.

The SIS model allows different conditions to be specified during the day and night. It is assumed that the temperature follows a sine-wave function, with the maximum daytime temperature (line 6) occurring between 3 pm and 4 pm and the minimum temperature (line 13) occurring between 3 am and 4 am. For wind speed and wind-direction offset angle, the transition between daytime and nighttime values uses a linear interpolation of the values for the four hours that follow both sunrise and sunset. When transitioning between daytime and nighttime stability, the stability class is allowed to change by only one class per hour. SIS uses the user-specified mixing height during the day and a mixing height of 5,000 meters at night.

Terrain Group

The CALPUFF/CALMET modeling system does not modify the wind field or puff trajectory based on local terrain information, but does adjust the puff height based on the local terrain using the plume path coefficient treatment method as implemented in CALPUFF. A diagram of the process is shown below (figure from the CALPUFF User Guides, Scire et. al, 2000).



In this figure, the adjusted puff height above ground (H_p) is given by:

$$H_p = H_{po} * C \quad \text{when } H_r > H_{po} \quad (2)$$

$$H_p = H_{po} - (H_r - H_s)(1 - C) \quad \text{when } H_r < H_{po} \quad (3)$$

where H_{po} is the unadjusted puff height, H_r is the height of the terrain, H_s is the height of the source, and C is the plume path coefficient. SIS uses the CALPUFF default values for C ; that is, $C=0.5$ for classes A, B, C, and D, and $C=0.35$ for classes E and F.

The terrain group input form is shown in the screen capture below. Step 1 is to specify the maximum downwind distance that will be considered within the modeling domain. The maximum allowable distance is 50 miles (80 km).

| Terrain Group | | |
|---------------|--|----------------------------|
| 15 | Enter maximum distance (miles) | 50 |
| 16 | Enter average elevation of fire (feet above msl) | 500 |
| 17 | Elevated terrain receptors? | Y |
| 18 | Enter terrain profile: | |
| | | Distance (miles) |
| | | Elevation (feet above msl) |
| | | 1 |
| | | 30 |
| | | 50 |
| | | 500 |
| | | 7,500 |
| | | 500 |

Step 2 is to specify whether elevated terrain receptors are to be used. If terrain receptors are desired, enter a "Y" on line 2. Otherwise, enter an "N." If a "Y" is entered, the air concentrations will be evaluated at the terrain elevations input by the user. If an "N" is entered, the air concentrations will be evaluated on the same plane as the fire (flat terrain).

Step 3 is to specify the base elevation of the fire. If multiple burn units are to be included in the run, enter the *average* base elevation of all the units. Note that terrain elevations that lie *below* the base elevation of the fire may be entered. This feature allows users to simulate the air concentrations that result from down slope, down valley flow conditions.

Step 4 is to enter the receptor distances and elevations in the straw-colored form below line 4. Enter a set of downwind distances from the fire in column 1 (in miles), and the terrain elevation at each of the downwind distances in column 2 (in feet above mean sea level). Single or multiple downwind distances may be specified. To specify multiple receptors, we recommend that the user select a smoke transport direction, and then use a ruler placed on a topographic map to locate distances and elevations along that line. There is no limit on the number of downwind points that may be selected.

CHAPTER 4

REFERENCES

Anderson, H.E. 1982. Aids to determining fuel models for estimating fire behavior. USDA For. Serv. Gen. Tech. Rep. INT-122. Intermountain For. and Range Exp. Stn., Ogden, Utah 84401. 22 pp.

Cohen, J.D., and J.E. Deeming. 1985. The National Fire-Danger Rating System: Basic Equations. Gen. Tech. Rep. PSW-82. Berkeley, CA: Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture. 16 pp.

Scire, J.S., D.G. Strimaitus, and R.J. Yamartino. 2000. A User's Guide for the CALPUFF Dispersion Model (Version 5.0). Earth Tech Inc. January 2000

APPENDIX A

Troubleshooting and Installation Issues

WARNING: Some of the resolutions listed below require making changes to the Windows Registry. Extreme care should be exercised when making changes to the registry because if done incorrectly, it could cause your computer to stop functioning. It is suggested that the user make a backup of the registry before modifying it. The user assumes responsibility for their machines and Air Sciences shall not be held responsible for any associated problems. If you are not comfortable performing any of these steps, please consult your local computer support staff for assistance.

ADDITIONAL WARNING: If you are using a Windows 2000, NT or XP machine, you need to make sure you are logged in with administrator rights (either as the administrator or as a user with administrator rights). If you do not have administrator rights, the resolutions may not work.

In general, installation and setup of SIS should be relatively trouble-free. To date, most reported installation problems have been associated with either the installation or application of CONSUME 2.1 on Windows 2000 machines; or on an incomplete installation of CONSUME 2.1 by the user.

Problem 1: Compiler Error

Upon opening SIS, a dialog box with the message:

Compiler Error:
Can't find project or library

Resolution to Problem 1

Typically, this error happens when CONSUME 2.1 has not been completely installed. For example, the install executable was downloaded but the SETUP.exe program was not run. To verify that this is the problem, do the following:

1. Open SIS (and click OK at the error message).
2. Open the Visual Basic Editor (Alt+F11) or "Tools/Macros/Visual Basic Editor" from the menu bar. NOTE: Multiple windows may appear. This is normal. Ignore them.
3. In the Editor, click Tools/References on the menu bar. A dialog box with a list of application names and check boxes will appear. Look for all entries with a "MISSING:" before the application name. If you find "USFS CONSUME ActiveX DLL" labeled as "MISSING:" then CONSUME 2.1 was not correctly installed.

Go back and re-check the CONSUME 2.1 installation instructions and verify that CONSUME 2.1 icons and program listing exists and will run.

Problem 2: CONSUME 2.1 Will Not Install

On some WINDOWS 2000 machines, CONSUME 2.1 will not install. The Install wizard get about half way through the install process and reports it cannot write files.

Resolution to Problem 2

We do not know what causes this error and do not have a fix (this is a problem with CONSUME 2.1 and not SIS). However, we have been able to bypass the install process by manually registering the CONSUME 2.1 DLLs so that SIS can use them.

Steps:

1. Open a command prompt (DOS window). A command window icon is usually under START/Programs/Accessories/Command Prompt
2. In the Command Window, type "CD C:\SIS\EXEC" (no quotes) and hit return. If you installed SIS in a directory other than "C:\SIS" then you will have to replace the C:\SIS with your SIS directory path.
3. Type "regsvr32 usfscax.dll" (no quotes) and hit return. You should get a message that says the DLL used was successfully registered. If you get a message in the command prompt window saying it cannot find the command or program, check your spelling and try again. If spelling is not the problem, then you will need to find where regsvr32 resides. Typically, it is in the system32 subfolder. That is under "C:\WINNT" or "C:\WINDOWS", depending on the operating system. Once found, use the full path name, type "C:\WINNT\SYSTEM32\regsvr32 usfscax.dll"
4. Type "regsvr32 dblast32.dll" (no quotes) and hit return. You should get a message that says the DLL used successfully registered.
5. Close the Command Prompt. Now you should be able to open SIS without the compiler error. NOTE: this may not resolve all of the CONSUME 2.1 issues.

Problem 3: CONSUME 2.1 Installed But PILE Wizard Will Not Install

On some Windows 2000 machines, executing the "Run Emissions Model" module for a pile burn scenario will result in error:

Error 429: ActiveX component can't create object

Resolution to Problem 3

This occurs when a supporting DLL is corrupt or not available, or when the registration key for the Access Database engine is not correctly referenced in the registry. In all instances, we have found that the registration key has been missing. Adding the key has often fixed the problem.

Steps:

1. Click START and select run
 2. In the "Run" window, type "regedit", (no quotes) and click OK. The registry editor will appear.
 3. Click "Registry" from the menu bar and select "Import Registry File ...". A "Open registry file" dialog box should appear.
 4. Use the browse to the SIS EXEC directory "C:\SIS\EXEC" and select the DAO.reg file and click the "Open" button.
 5. Close the Registry editor and open SIS. The pile wizard should now work.
-

Problem 4: Intermittent Problem When "Make Puff Charts" Button is Pressed

We are aware of an intermittent problem that occurs in SIS that typically occurs when the "Make Puff Charts" button is pressed (it can also appear in other SIS modules). The problem results in a message like:

```
runtime error-'2147417848(80010) Method 'Clear Context' failed
```

Other methods (e.g. copy, clear, write,...) may fail as well.

Resolution to Problem 4

We do not know the exact cause of this error. However, we suspect it is related with Microsoft Excel memory allocation issues that crop up when certain operations are performed repeatedly. These actions include:

- Creating or copying charts
- Deleting and clearing sheets and charts
- Working with large amounts of data
- Process automation

We have attempted to code SIS in such a way that this error is minimized (although, we do not think it has been eliminated).

If this problem does occur, then exit completely out of both SIS and Excel, and then restart SIS. If this problem occurs frequently, please e-mail your SIS workbook to Kent Norville, Air Sciences (knorville@airsci.com) with a description of how the problem occurred.

APPENDIX B
Guidance for First Order Fire Effects Model Version 5
(FOFEM5)

Section VI¹

FIRST ORDER FIRE EFFECTS MODEL (FOFEM5)

Overview

Technical Description

Notes

Strengths

Weaknesses

Common Misuses

Operational Hints

¹ Training Materials Presented in Smoke Emissions and Dispersion Modeling Course, March 15, 2001, Clovis, California. USDA Forest Service, California Region.

FOFEM5 – First Order Fire Effects Model

Technical Description

Type of Model

- Emissions production model
- Does not include dispersion or visibility
- Also evaluates tree mortality (limited to western coniferous tree species and aspen greater than 1 inch in diameter), fuel consumption, and soil exposure

Developer

- Developed by the USDA Forest Service Intermountain Research Station, Fire Sciences Laboratory, in the early 1990's for purposes of calculating quantitative fire effects relationships.
- FOFEM 5.0 (beta version) completed in 2001.

FOFEM5 – First Order Fire Effects Model

Technical Description

Domain

- U.S. is divided into four geographical regions: Pacific West, Interior West, North East, and South East
- Evaluates vegetation cover types found throughout the United States

Intended Application

- Assess single fires on a unit-area basis
- Designed to help fire managers assess the probable impacts of wildland fire by providing predictions of emissions, fuel consumption (including soil exposure), tree mortality, and soil heating based on a specific burn prescription.

FOFEM5 – First Order Fire Effects Model

Technical Description

Mode of Operation

- Interactive, Windows based

Minimum System Recommended

- Windows 95, 98, NT
- 32 MB RAM

Pollutant Types

- PM_{2.5}, PM₁₀, CO, CO₂, CH₄ (methane)

Fuel Types

- Uses Society of American Foresters/Society of Range Management (SAF/SRM), National Vegetation Classification System (NVCS), and Fuel Characteristic Classes (FCC); available fuel types vary by region

FOFEM5 – First Order Fire Effects Model

Technical Description

Fuel Category

- Natural fuels and activity fuels (e.g., piles and slash)

Number of Burn Units

- Single unit; emissions computed on a unit-area basis

FOFEM5 – First Order Fire Effects Model

Technical Description

Input Requirements

| SOURCE PARAMETERS | OPTIONS | UNITS |
|------------------------------|---|--------------|
| Geographic Region | Pacific West, Interior West, North East, South East | — |
| Vegetation Cover Type | Default SAF/SRM, NVCS, and FCCs available by region | — |
| Fuel Category | Natural, piles or slash | — |
| Dead Fuel Adjustment Factor* | Typical, light, heavy, or user specified | — |
| Moisture Conditions** | Very dry, dry, moderate, wet | — |

* *Affects default loadings for all fuel bed components*

***Affects default 10-hour, 1,000-hour, and duff moisture contents*

FOFEM5 – First Order Fire Effects Model

Technical Description

Input Requirements

| SOURCE PARAMETERS | OPTIONS | UNITS |
|---|--|--------------|
| Tree Crown Biomass Loading (Foliage, Branch) | Typical, sparse, abundant, user-specified | — |
| Vegetation Density Herbaceous Shrub | Typical, sparse, abundant, user-specified Typical, sparse, abundant, user-specified | — |
| Season of Burn | Spring, summer, fall, winter | — |

FOFEM5 – First Order Fire Effects Model

Technical Description

Input Requirements

| SOURCE PARAMETERS | OPTIONS | UNITS |
|--|---------|-----------|
| Fuel Loadings Litter 0-1/4 inch (1 hour) 1/4-1 inch (10 hour) 1-3 inch (100 hour) 3+ inch (1,000 hour+) Duff Herbs Shrubs Crown foliage Crown small branchwood | — | tons/acre |

FOFEM5 – First Order Fire Effects Model

Technical Description

Input Requirements

| SOURCE PARAMETERS | OPTIONS | UNITS |
|---------------------------------------|---|---------|
| Fuel-Moisture Method: Duff | National Fire Danger Rating System 1000-hour (NFDR), Adjusted NFDR (Adj. NFDR = NFDR x 1.4), measured samples from lower or entire duff layer | percent |
| Weight Distribution for 3+ Woody Fuel | Right, left, even, end, center | — |

FOFEM5 – First Order Fire Effects Model

Technical Description

Input Requirements

| SOURCE PARAMETERS | OPTIONS | UNITS |
|--|-------------|-------------------------------|
| Fuel Moisture: Duff ¼-1 inch wood (10 hr) 3+ inch wood (1,000 hr) | — — — | percent percent percent |
| Crown Foliage and Fine Branchwood That Will Burn | — | percent |
| Percent Down Woody Fuel That is Rotten | — | percent |
| Preburn Duff Depth | — | inches |

FOFEM5 – First Order Fire Effects Model

Technical Description

Output

- FOFEM Smoke Option—Tables: Fuel consumption (tons/acre) for each fuel component and size class, mineral soil exposure (%) and duff depth reduction (inches), emissions (lbs/acre) for each pollutant type (flaming, smoldering, total), total consumption (tons/acre; flaming, smoldering, total).
- FOFEM Smoke Option—Graphs: Emission rate (lbs per second per acre) by pollutant type (choose one of five species), or fire intensity (kilowatts per square meter of fire).
- Reports may be saved in a file by selecting **Report, Save Report to File** on menu. Graphs may be saved in a file by selecting **Graph, Save to File** on menu.

*Note: FOFEM5 saves graphs in a file with an emf (enhanced metafile) extension. This file format is not recognized by many applications, but can be imported into a Word document via the **Insert, Picture, From File** menu item in Word 2000.*

FOFEM5 – First Order Fire Effects Model

Strengths

- “First order fire effects” refers to the immediate effects of a fire, not the long-term impacts.
- Assumes that the entire area of concern experiences fire (no mosaic of burned and unburned areas).
- “Burnup” model used to predict woody fuel and litter consumption.
- Duff, herbs, shrubs, and crown consumption are based on set of predictive equations that vary by vegetation type and moisture conditions.
- Default fuel loadings available for multiple SAF/SRM, NVCS, and FCC vegetation types.
- Emission factors are computed based on combustion efficiency; each fuel size component has a combustion efficiency assigned for flaming and smoldering consumption.

FOFEM5 – First Order Fire Effects Model

Strengths

- Current version of FOFEM creates a file that may (in future) be used as input to NFSPUFF3.
- Easy-to-use, Windows-based application
- Applicable to entire United States, and includes vegetation types specific to each region
- Default loading values available for different cover types, or user may enter specific values
- Default moisture contents available for four different moisture regimes, or user may enter specific values
- Uses state-of-the-science model (Burnup) for woody fuel and litter consumption
- For duff, herb, shrub, and crown foliage consumption, decision key selects the best available algorithm for the conditions specified by user

FOFEM5 – First Order Fire Effects Model

Strengths

- Built-in error checking for invalid entries (for example, no 10-hour fuel moistures less than 3 percent accepted)

FOFEM5 – First Order Fire Effects Model

Weaknesses

- Not all fields have easy-to-interpret labels (some are missing altogether!)
- Some minor bugs exist in forms. For example, when the user opens FOFEM5 for the first time and selects the Smoke option, the form displays multiple loading adjustment fields (i.e., typical, light, heavy, user) under the fuel size classes even though the cover type classification option is “FCC”; these fields do not apply to FCCs. To refresh the screen, simply reselect the FCC cover type option.
- *Menu-based* Help system is currently inactive.
- Season of burn has no effect on fuel consumption or emissions.
- Summary report does not correctly summarize emissions, nor does it summarize all pollutants (missing CO₂ and CH₄).

FOFEM5 – First Order Fire Effects Model

Common Misuses

- Using to predict fire effects for patchy or non-uniform burns.
- Incorrectly matching FOFEM default fuel profiles to site.

FOFEM5 – First Order Fire Effects Model

Operational Hints

- Help screens are available for each screen by clicking mouse in desired field, then pressing F1 function key.
- No help is currently available on the menu.

Hands-On Session #1

FIRST-ORDER FIRE EFFECTS MODEL (FOFEM5)²

Present Training Objectives

Review Data Requirements

Define Modeling Scenario

Prepare Data Inputs and Generate Reports

Student Exercise

² Training Materials Presented in Smoke Emissions and Dispersion Modeling Course, March 15, 2001, Clovis, California. USDA Forest Service, California Region.

Present Training Objectives

General

To learn to use the FOFEM5 model for predicting smoke emissions from wildland fires.

Specific

- A. To compute PM_{10} and $PM_{2.5}$ emissions on a 1,000-acre spring underburn of natural fuels in an open-grown ponderosa pine stand in the Swithins Drainage, California.
- B. To determine the minimum 1,000-hour fuel moisture content that will limit total PM_{10} emissions to 100 tons or less.

Review Data Requirements

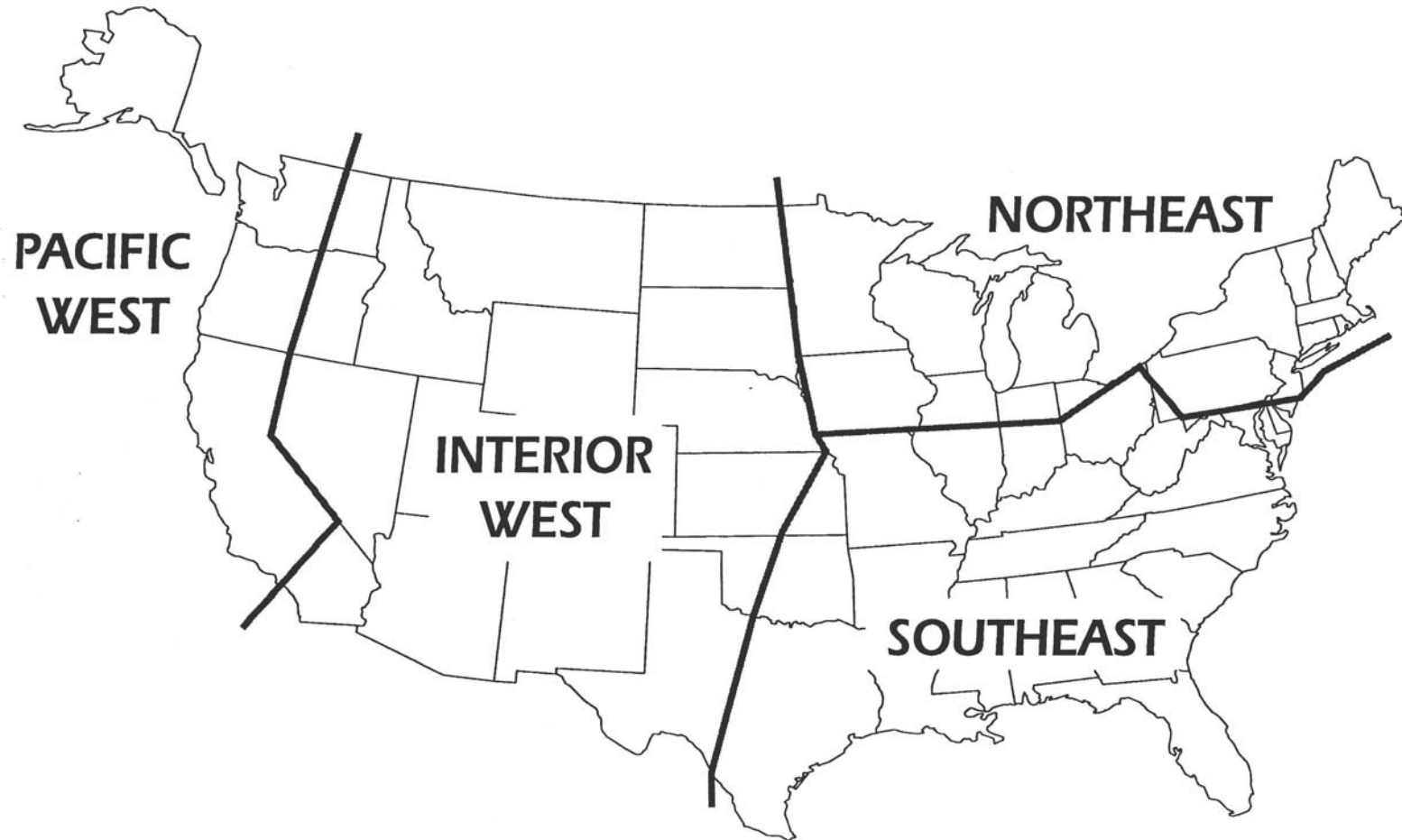
| SOURCE PARAMETERS | OPTIONS | SOURCES |
|------------------------------|---|----------------------|
| Geographic Region | Pacific West, Interior West, North East, South East | See map on next page |
| Vegetation Cover Type | Default SAF/SRM, NVCS, and FCCs available by region | — |
| Fuel Category | Natural, piles or slash | — |
| Dead Fuel Adjustment Factor* | Typical, light, heavy, or user specified | — |
| Moisture Conditions** | Very dry, dry, moderate, wet | — |

* *Affects default loadings for all fuel bed components*

***Affects default 10-hour, 1,000-hour, and duff moisture contents*

Review Data Requirements

Geographic Regions for Specifying Site Location



Review Data Requirements

| SOURCE PARAMETERS | OPTIONS | SOURCES |
|---|---|----------------|
| Tree Crown Biomass Loading (Foliage, Branch) | Typical, sparse, abundant, user-specified | — |
| Vegetation Density Herbaceous Shrub | Typical, sparse, abundant, user- specified Typical, sparse, abundant, user-specified | — |
| Season of Burn | Spring, summer, fall, winter | — |

Review Data Requirements

| SOURCE PARAMETERS | OPTIONS | SOURCES |
|--|---------|---------|
| Fuel Loadings Litter 0-1/4 inch (1 hour) 1/4-1 inch (10 hour) 1-3 inch (100 hour) 3+ inch (1,000 hour+) Duff Herbs Shrubs Crown foliage Crown small branchwood | — | — |

Review Data Requirements

| SOURCE PARAMETERS | OPTIONS | SOURCES |
|--|-----------------------------------|----------------------|
| Fuel-Moisture Method: Duff | NFDR, Adj_NFDR, lower, entire | — |
| Weight Distribution for 3+ Woody Fuel | Right, left, even, end, center | Default is “Even” |

Review Data Requirements

| SOURCE PARAMETERS | OPTIONS | SOURCES |
|--|----------------|---------------------------------|
| Fuel Moisture: Duff ¼-1 inch wood (10 hr) 3+ inch wood (1,000 hr) | — — — | — — — |
| Crown Foliage and Fine Branchwood That Will Burn | — | Wildfire default is “50%” |
| Percent Down Woody Fuel That is Rotten | — | — |
| Pre-burn Duff Depth | — | — |

Define Modeling Scenario

- Spring burn in open-grown ponderosa pine stand in the Interior West Region (SAF 237, Interior Ponderosa Pine)
- Understory burn in natural fuels; overstory crowns are not expected to burn.
- Unit is 1,000 acres in size.
- Assume “moderate” moisture conditions, except assume 12 percent 10-hour fuel moisture content (measured with fuel sticks).

Prepare Data Inputs and Create Reports

To initiate program, click on **Start, Programs, FOFEM5** or click on Desktop Icon. This is the first screen that appears. Note that the upper left set of “radio buttons” defaults to “Fuel.” In this class, we will only deal with the “Smoke” option:

The screenshot shows the FOFEM 5.00 software interface. The title bar reads "FOFEM - Version: 5.00 - Jan 21 2001". The menu bar includes "Project", "Report", "Graph", "View", "Options", "Help", and "Exit". The main window contains several input fields and a table of fuel data.

At the top, there are radio buttons for "Mortality", "Fuel" (selected), "Smoke", and "Soil". To the right are dropdown menus for "Interior_West" and "FCC". Below these are more dropdown menus for "1-PP-Ponderosa-Bare ground-Low-(None)-(none)", "Spring", "Moderate", and "Natural-Fuel".

| Fuels | Litter | 0-1/4 | 1/4-1 | 1-3 | 3+ | Duff | Herb | Shrub | Foliage | Branch |
|------------|--------|-------|-------|------|------|------|------|-------|---------|--------|
| Tons/Acre | 0.68 | 0.50 | 0.80 | 1.70 | 4.90 | 1.59 | 0.30 | 0.40 | 0.00 | 0.00 |
| Adjustment | Typ | Typ | Typ | Typ | Typ | Typ | Typ | Typ | Typ | Typ |
| Moisture % | | 25 | | 20 | 100 | | | | | 0 |
| | | | | 10.0 | 0.30 | | | | | |

Below the table are dropdown menus for "Even" and "Entire", and a "Summaries:" section with a text input field and radio buttons for "Y" and "N".

At the bottom, there is a text field labeled "This is a user comment field." and a button labeled "Check this button to estimate Fuel Consumption."

Now, let's examine each of the fields on the input section of this form.

Prepare Data Inputs and Create Reports

Some fields are not labeled. For a description of the field at A, click inside the field and review the description on the gray bar at B.

The screenshot shows the FOFEM software interface. The title bar reads "FOFEM - Version: 5.00 - Jan 21 2001". The menu bar includes "Project", "Report", "Graph", "View", "Options", "Help", and "Exit". The main window contains several controls: radio buttons for "Mortality", "Fuel", "Smoke", and "Soil"; a project path "C:\MODELS\Fofem5\Projects\region5.prj"; dropdown menus for "Interior_West" and "SAF/SRM"; and a section for "SAF 237 - Interior Ponderosa Pine" with dropdowns for "Spring", "Moderate", and "Natural-Fuel".

| Fuels | Litter | 0-1/4 | 1/4-1 | 1-3 | 3+ | Duff | Herb | Shrub | Foliage | Branch |
|------------|--------|-------|-------|------|------|------|------|-------|---------|--------|
| Tons/Acre | 1.40 | 0.07 | 0.63 | 0.80 | 5.00 | 5.00 | 0.20 | 0.40 | 6.00 | 0.70 |
| Adjustment | Typ | Typ | Typ | Typ | Typ | Typ | Typ | Typ | Typ | Typ |
| Moisture % | | 12 | | 20 | 100 | | | | | 0 |
| | | | | 10.0 | 0.60 | | | | | |

Below the table are dropdown menus for "Even" and "Entire", and a "Summaries:" section with radio buttons for "Y" and "N".

Annotation A: An arrow points to the "10.0" value in the "Moisture %" row under the "3+" column.

Annotation B: An arrow points to a gray tooltip bar that reads "Enter the percentage of down woody fuel that is rotten".

Prepare Data Inputs and Create Reports

Help can be obtained for individual fields by clicking inside the field and then pressing the F1 key. This illustrates the help text for the “Percent of Tree Crowns That Burn” field at A.

The screenshot shows the FOFEM software interface (Version 5.00, Jan 21 2001) with a help dialog box open. The dialog box is titled "Percent of Canopy Burned" and contains the following text:

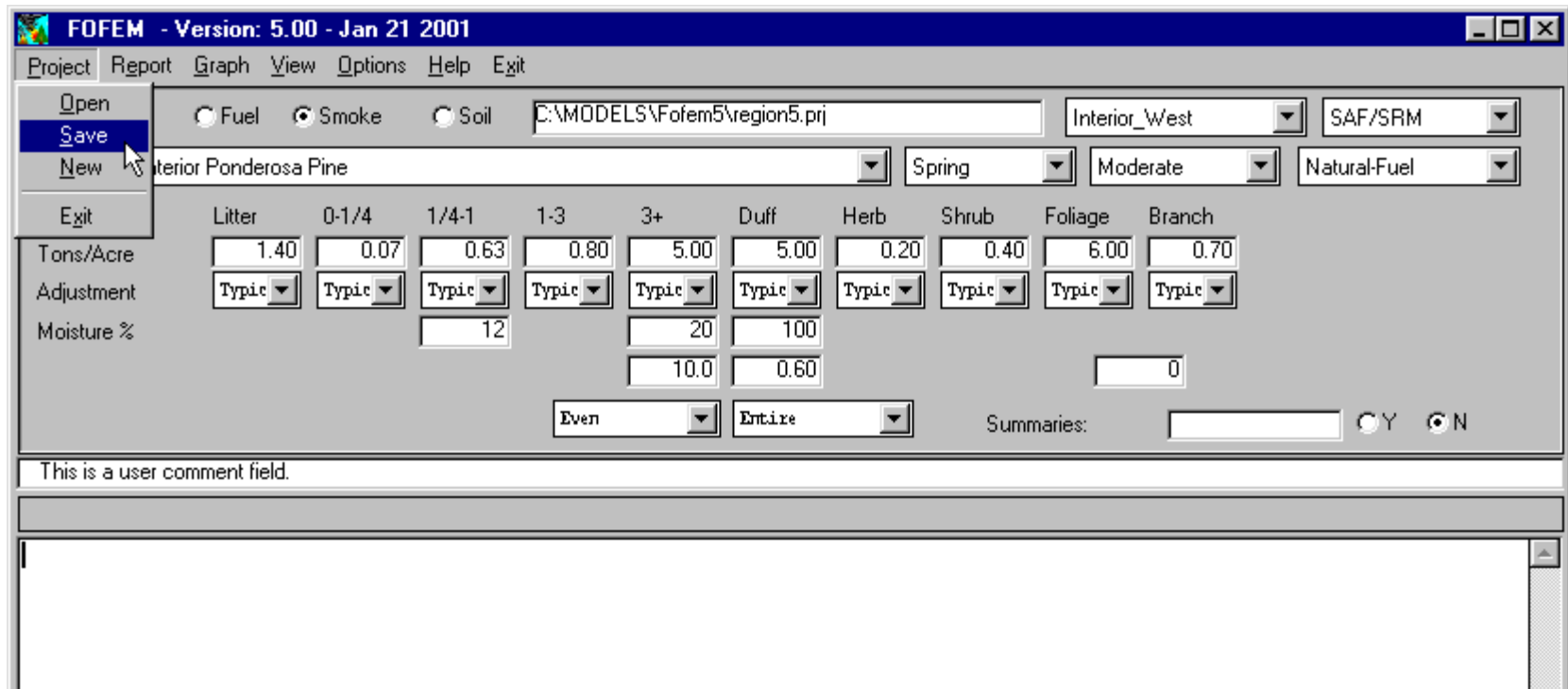
Enter percent of tree canopy to be burned. This option allows you to predict emissions from crown fire. FOFEM does not model fire behavior, so you are required to enter the expected amount of crown fire. Range is 0 (no crown fire) to 100% for a continuous crown fire. For fires with some torching select an intermediate value.

An arrow labeled 'A' points to the input field for the "Percent of Canopy Burned" field in the main interface, which currently contains the value 0.

| Fuels | Litter | 0-1/4 | 1/4-1 | 1-3 | 3+ | Duff | Herb | Shrub | Foliage | Branch |
|------------|--------|-------|-------|------|------|------|------|-------|---------|--------|
| Tons/Acre | 1.40 | 0.07 | 0.63 | 0.80 | 5.00 | 5.00 | 0.20 | 0.40 | 6.00 | 0.70 |
| Adjustment | Typ. | Typ. | Typ. | Typ. | Typ. | Typ. | Typ. | Typ. | Typ. | Typ. |
| Moisture % | | 12 | | 20 | 100 | | | | | |

Prepare Data Inputs and Create Reports

Now, let's examine the items on the menu. The **Project** menu options include:



Saving a project (*.prj) saves only the inputs, not any of the outputs (reports and graphs) that have been generated.

Prepare Data Inputs and Create Reports

Report menu options include:

The screenshot shows the FOFEM software interface. The 'Report' menu is open, displaying the following options: 'Create Report' (Ctrl+R), 'Clear Report', 'Save Report to File', 'Print Report', 'Create Summary Report', and 'Clear Stored Summaries'. The main window displays a report titled 'Results of FOFEM model execution on date: 3/6/2001'. The report content is as follows:

```

TITLE: Results of FOFEM model execution on date: 3/6/2001

          FUEL CONSUMPTION CALCULATIONS

Region:      Interior_West
Cover Type:  SAF/SRM - SAF 237 - Interior Ponderosa Pine
Fuel Type:   Natural
Fuel Reference:  FOFEM 011

          FUEL CONSUMPTION TABLE

Fuel Component Name      Preburn Load (t/acre)  Consumed Load (t/acre)  Postburn Load (t/acre)  Percent Reduced (%)  Equation Reference Number  Moisture
-----
Litter                  1.40                   1.40                    0.00                   100.0                999
Wood (0-1/4 inch)      0.07                   0.07                    0.00                   100.0                999
    
```

The report contents are as follows:

Prepare Data Inputs and Create Reports

~~~~~  
 TITLE: Results of FOFEM model execution on date: 3/8/2001

## FUEL CONSUMPTION CALCULATIONS

Region: Interior\_West  
 Cover Type: SAF/SRM - SAF 237 - Interior Ponderosa Pine  
 Fuel Type: Natural  
 Fuel Reference: FOFEM 011

| FUEL CONSUMPTION TABLE |                       |                        |                        |                     |                           |          |
|------------------------|-----------------------|------------------------|------------------------|---------------------|---------------------------|----------|
| Fuel Component Name    | Preburn Load (t/acre) | Consumed Load (t/acre) | Postburn Load (t/acre) | Percent Reduced (%) | Equation Reference Number | Moisture |
| Litter                 | 1.40                  | 1.40                   | 0.00                   | 100.0               | 999                       |          |
| Wood (0-1/4 inch)      | 0.07                  | 0.07                   | 0.00                   | 100.0               | 999                       |          |
| Wood (1/4-1 inch)      | 0.63                  | 0.63                   | 0.00                   | 100.0               | 999                       | 12.0     |
| Wood (1-3 inch)        | 0.80                  | 0.53                   | 0.27                   | 66.1                | 999                       |          |
| Wood (3+ inch) Sound   | 4.50                  | 0.34                   | 4.16                   | 7.5                 | 999                       | 20.0     |
| 3->6                   | 1.12                  | 0.18                   | 0.94                   | 0.2                 |                           |          |
| 6->9                   | 1.12                  | 0.09                   | 1.03                   | 0.1                 |                           |          |
| 9->20                  | 1.12                  | 0.05                   | 1.08                   | 0.0                 |                           |          |
| 20->                   | 1.12                  | 0.02                   | 1.11                   | 0.0                 |                           |          |
| Wood (3+ inch) Rotten  | 0.50                  | 0.10                   | 0.40                   | 19.8                | 999                       | 20.0     |
| 3->6                   | 0.12                  | 0.05                   | 0.08                   | 0.4                 |                           |          |
| 6->9                   | 0.12                  | 0.03                   | 0.10                   | 0.2                 |                           |          |
| 9->20                  | 0.12                  | 0.02                   | 0.11                   | 0.1                 |                           |          |
| 20->                   | 0.12                  | 0.01                   | 0.12                   | 0.1                 |                           |          |
| Duff                   | 5.00                  | 2.05                   | 2.95                   | 41.1                | 2                         | 100.0    |
| Herbaceous             | 0.20                  | 0.20                   | 0.00                   | 100.0               | 22                        |          |
| Shrubs                 | 0.40                  | 0.24                   | 0.16                   | 60.0                | 23                        |          |
| Crown foliage          | 6.00                  | 0.00                   | 6.00                   | 0.0                 | 37                        |          |
| Crown branchwood       | 0.70                  | 0.00                   | 0.70                   | 0.0                 | 38                        |          |
| <b>Total Fuels</b>     | <b>20.20</b>          | <b>5.56</b>            | <b>14.64</b>           | <b>27.5</b>         |                           |          |

## FIRE EFFECTS ON FOREST FLOOR COMPONENTS

| Forest Floor | Preburn Amount | Postburn Amount | Percent | Equation |
|--------------|----------------|-----------------|---------|----------|
|--------------|----------------|-----------------|---------|----------|

# Prepare Data Inputs and Create Reports

| Component        | Condition Consumed |      | Condition Reduced |      | Number |
|------------------|--------------------|------|-------------------|------|--------|
| Duff Depth (in)  | 0.6                | 0.2  | 0.4               | 30.8 | 6      |
| Min Soil Exp (%) | .0                 | 21.9 | 21.9              | 21.9 | 10     |

Note:

'Duff' (tons/acre) and 'Duff Depth (in)' burned are computed using different equations, sometimes this may cause an inconsistency in the 'Percent Reduced' shown on this report. Duff (tons/acre) consumed is best suited for predicting smoke production, while Duff Depth (in) may be better related to fire severity and soil heating

|        | Emissions -- lbs/acre |            |       |
|--------|-----------------------|------------|-------|
|        | flaming               | smoldering | total |
| PM 10  | 12                    | 196        | 208   |
| PM 2.5 | 10                    | 166        | 176   |
| CH 4   | 3                     | 101        | 104   |
| CO     | 25                    | 2216       | 2241  |
| CO 2   | 6725                  | 9018       | 15743 |

|             | Consumption<br>tons/acre | Duration<br>hour:min:sec |
|-------------|--------------------------|--------------------------|
| Flaming:    | 3.39                     | 00:01:00                 |
| Smoldering: | 5.85                     | 00:22:15                 |
| Total:      | 9.24                     |                          |



# Prepare Data Inputs and Create Reports

A **Summary Report** summarizes the fuel consumption and emissions data from multiple **Reports**:

The screenshot shows the FOFEM software interface. The 'Report' menu is open, and 'Create Summary Report' is highlighted. The main window displays various input fields and a table of fuel characteristics.

**Project Information:**

- Project Name: MODELS\Fofem5\region5.prj
- Location: Interior\_West
- Fuel Type: SAF/SRM
- Season: Spring
- Weather: Moderate
- Fuel Source: Natural-Fuel

**Fuel Characteristics Table:**

|            | 3+     | Duff | Herb | Shrub | Foliage | Branch |
|------------|--------|------|------|-------|---------|--------|
| 0.80       | 5.00   | 5.00 | 0.20 | 0.40  | 6.00    | 0.70   |
| Typ        | Typ    | Typ  | Typ  | Typ   | Typ     | Typ    |
| Moisture % | 10     | 20   | 100  |       |         |        |
|            | 10.0   | 0.60 |      |       | 0       |        |
| Even       | Entire |      |      |       |         |        |

**Summary Table:**

| Name      | Litter | Wood 0->1/4 | Wood 1/4->1 | Wood 1->3 | Wood 3+ | Duff | Herb | Shrub | Crown |
|-----------|--------|-------------|-------------|-----------|---------|------|------|-------|-------|
| 12% 10-Hr | 1.40   | 0.07        | 0.63        | 0.53      | 0.44    | 2.05 | 0.20 | 0.24  | 0.00  |
| 10% 10-Hr | 1.40   | 0.07        | 0.63        | 0.54      | 0.44    | 2.05 | 0.20 | 0.24  | 0.00  |

**Smoke Emission Totals:**

| Name      | Ave Combust Efficiency | PM10 Emission (lbs/acre) | PM2.5 Emission (lbs/acre) | CO Emission (lbs/acre) |
|-----------|------------------------|--------------------------|---------------------------|------------------------|
| 12% 10-Hr | 0.00                   | 0.0                      | 0.0                       | 0.0                    |
| 10% 10-Hr | 0.00                   | 0.0                      | 0.0                       | 0.0                    |
| Totals    | 0.00                   | 0.0                      | 0.0                       | 0.0                    |

# Prepare Data Inputs and Create Reports

The order of operations for Creating and Reviewing a Summary Report is as follows:

1. Click Y on “Summaries” radio button (middle right side of form).

The screenshot shows the FOFEM software interface. The title bar reads "FOFEM - Version: 5.00 - Jan 21 2001". The menu bar includes "Project", "Report", "Graph", "View", "Options", "Help", and "Exit". The main window contains several controls:

- Radio buttons for "Mortality", "Fuel", "Smoke" (selected), and "Soil".
- File path: "C:\MODELS\Fofem5\Projects\region5.pri"
- Dropdowns for "Interior\_West" and "SAF/SRM".
- Text field: "SAF 237 - Interior Ponderosa Pine"
- Dropdowns for "Spring", "Moderate", and "Natural-Fuel".
- Table of fuel parameters:

| Fuels      | Litter | 0-1/4 | 1/4-1 | 1-3  | 3+   | Duff | Herb | Shrub | Foliage | Branch |
|------------|--------|-------|-------|------|------|------|------|-------|---------|--------|
| Tons/Acre  | 1.40   | 0.07  | 0.63  | 0.80 | 5.00 | 5.00 | 0.20 | 0.40  | 6.00    | 0.70   |
| Adjustment | Typ    | Typ   | Typ   | Typ  | Typ  | Typ  | Typ  | Typ   | Typ     | Typ    |
| Moisture % |        | 12    |       | 25   | 100  |      |      |       |         | 0      |
|            |        |       |       | 10.0 | 0.60 |      |      |       |         |        |

Below the table are dropdowns for "Even" and "Entire". To the right, the "Summaries:" label is followed by a text field containing "25% TH FM" and two radio buttons, "Y" (selected) and "N".

At the bottom, there is a text field with the placeholder "This is a user comment field."

2. Provide a summary name in the blank field to the right of “Summaries.” Choose a name that reflects the parameter(s) being changed and compared. For example, “25% TH FM” for “25% 1,000-hour fuel moisture content.”

## **Prepare Data Inputs and Create Reports**

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3. Create report.
4. Change the parameter (in this case, we will change the 25% 1,000-hour fuel moisture to 30% 1,000-hour fuel moisture.
5. Rename the summary. In this case, we chose “30% TH FM.”
6. Create a new report.
7. Repeat Steps 4 – 6 as often as needed.

# Prepare Data Inputs and Create Reports

8. Create the summary report. Note the summary names on the report.

| Fuel Consumed Totals - (t/acre) |        |        |        |      |      |      |      |       |       |       |
|---------------------------------|--------|--------|--------|------|------|------|------|-------|-------|-------|
| Name                            |        | Wood   | Wood   | Wood | Wood |      |      |       |       | Crown |
| Id                              | Litter | 0->1/4 | 1/4->1 | 1->3 | 3+   | Duff | Herb | Shrub | Folge |       |
| 25% TH FM                       | 1.40   | 0.07   | 0.63   | 0.52 | 0.37 | 2.05 | 0.20 | 0.24  | 0.00  |       |
| 30% TH FM                       | 1.40   | 0.07   | 0.63   | 0.52 | 0.29 | 2.05 | 0.20 | 0.24  | 0.00  |       |

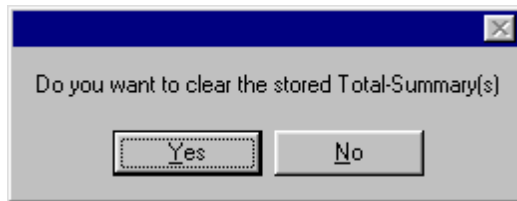
  

| Smoke Emission Totals |             |               |                |             |
|-----------------------|-------------|---------------|----------------|-------------|
| Name                  | Ave Combust | PM10 Emission | PM2.5 Emission | CO Emission |
| Id                    | Efficiency  | (lbs/acre)    | (lbs/acre)     | (lbs/acre)  |
| 25% TH FM             | 0.00        | 0.0           | 0.0            | 0.0         |
| 30% TH FM             | 0.00        | 0.0           | 0.0            | 0.0         |
| -----                 |             |               |                |             |
| Totals                | 0.00        | 0.0           | 0.0            | 0.0         |

## Prepare Data Inputs and Create Reports

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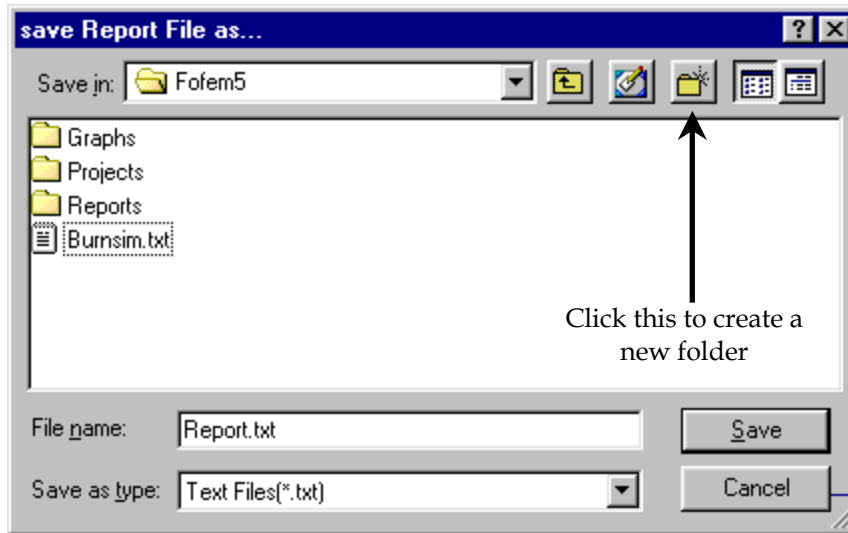
9. Note that the program will query the user whether they want to clear the stored totals. Press “yes” if you want to delete the summary information; press “no” if you want to keep the totals and create updated summaries with more reports:



10. To stop creating summaries, click on the N radio button to the right of Summaries, and blank out the summary name field.
11. To save the report, click on **Report, Save Report to File**. The following browser box will appear; note that clicking on the icon that the arrow is pointing to allows the user to create a new folder (we called this one “Reports.”):

# Prepare Data Inputs and Create Reports

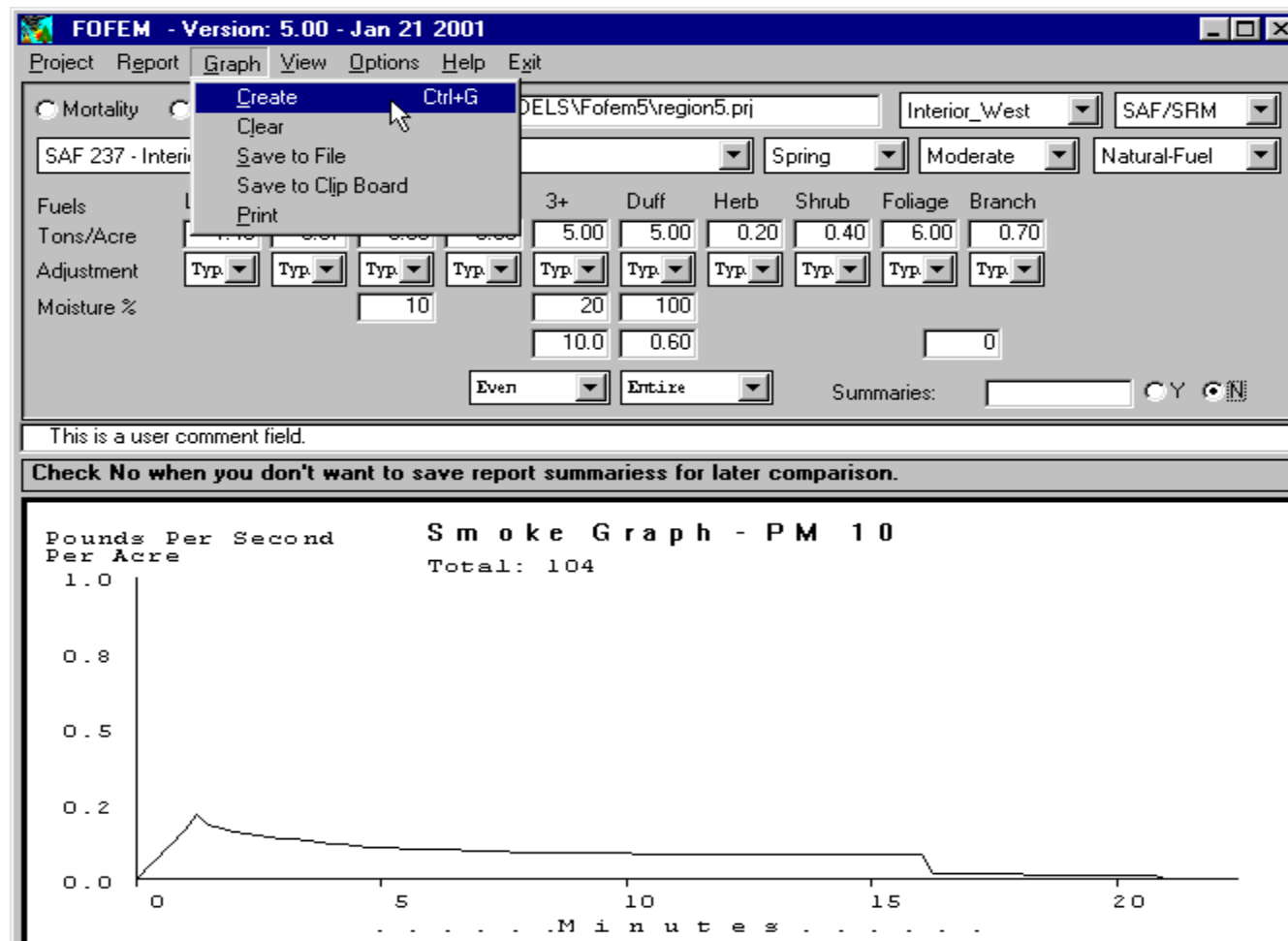
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12. Note that saving a file saves *everything* displayed on the lower half of the screen.

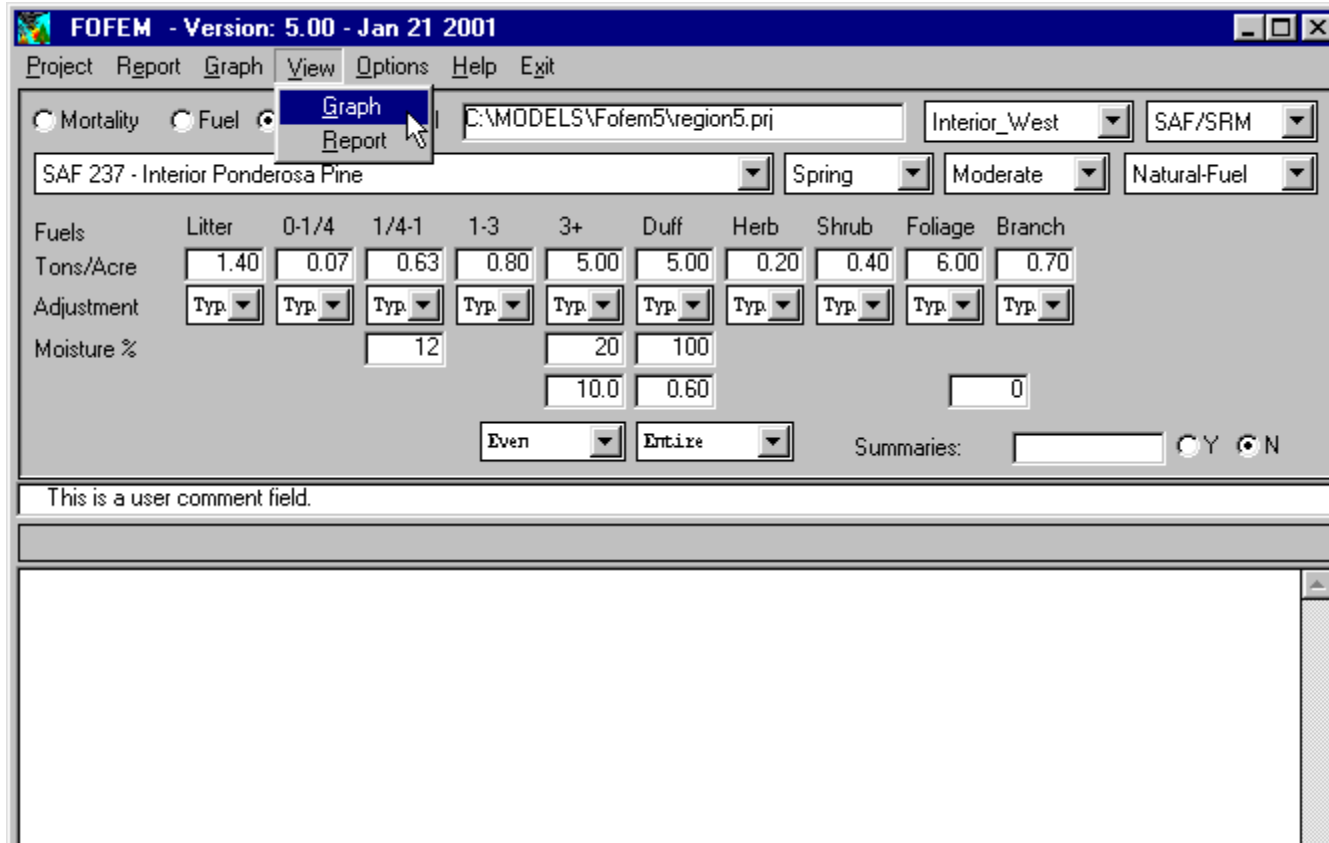
# Prepare Data Inputs and Create Reports

**Graph** menu options include (select one of five pollutants, or fire intensity):



# Prepare Data Inputs and Create Reports

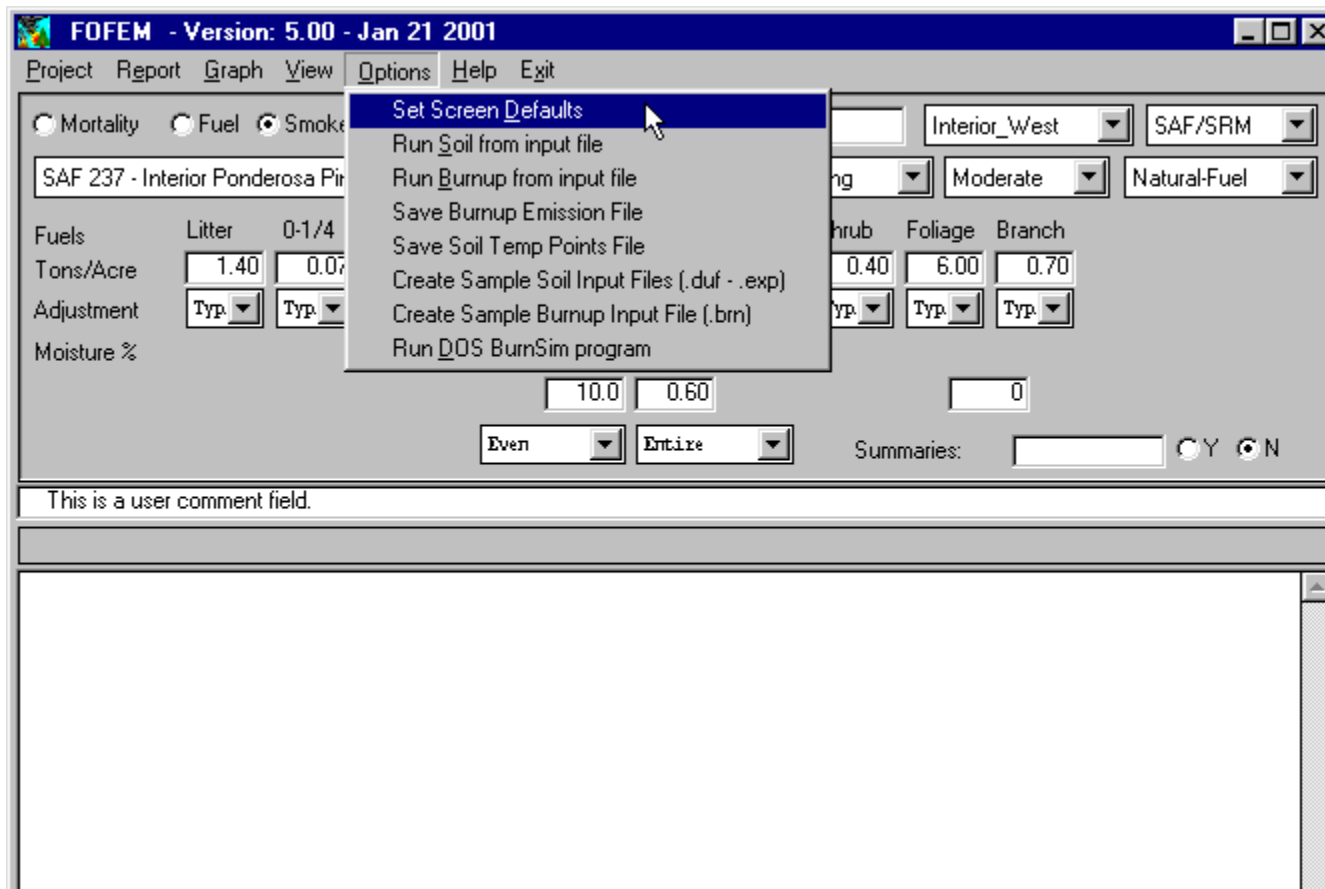
The **View** menu allows the user to toggle between the most recently created graph and report:





# Prepare Data Inputs and Create Reports

The **Options** menu contains many options that the average user will never need to exercise:



# Prepare Data Inputs and Create Reports

The **Help** menu contains “Help” and “About”, but only the “About” feature is currently active:



