NONROAD-AT: A Database Tool for Managing Off-Road Emissions Scenarios Created with EPA=s NONROAD Model

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ABSTRACT

User=s of EPA=s off-road emissions model, NONROAD, often have a need to easily store and retrieve information from multiple scenarios corresponding to different regulatory strategies, time periods, and locations. NONROAD-AT is a software tool developed by ENVIRON for the state of Texas to assist in the development, documentation, and archiving of multiple off-road emissions scenarios. NONROAD-AT includes as a separate, replaceable module the current Afinal draft@ version of EPA=s NONROAD core model which can be used to estimate both historical and future year emissions from most off-road equipment. NONROAD-AT builds on the capabilities of the NONROAD core model and the current NONROAD Graphical User Interface (GUI) and Reporting Utility by providing users with the ability to define, document, store, and report results from multiple NONROAD emission scenarios. NONROAD-AT includes the ability to compare emissions from one scenario with those from another, to recall, modify, and re-analyze previously defined scenarios, and to share scenario data with other NONROAD-AT users. In addition to various summary reports, NONROAD-AT users can obtain detailed emission outputs in EPS2 and NIF2.0 file formats for use with other emissions processing and database systems. NONROAD-AT provides this functionality via a simple graphical, menu-driven user interface which will be familiar to current NONROAD users. Data on off-road equipment population, activity, and emission factors for use with the NONROAD core model were previously developed with EPA funding. These AEPA Default@ input data can be used to calculate off-road emissions for any county or state within the U.S. and are included with the NONROAD-AT distribution. Additional NONROAD input files containing revised data for counties in Texas were also developed for use with NONROAD-AT. These files include revised population, growth factor, activity, and emission factor data specific to Texas. Data specifically developed for other states can be easily added to the system.

INTRODUCTION

In recognition of the increasing role of off-road mobile sources in air quality planning activities, EPA sponsored development of the NONROAD mobile source emissions model to assist the States and others in development of more accurate off-road mobile source inventories. The EPA NONROAD mobile source emissions model is currently available as a draft version.[1] The draft version of the model estimates emissions from most types of off-road equipment except commercial marine, locomotive, and aircraft equipment. Engine types covered by the model include two- and four-stroke gasoline and diesel, CNG, and LPG engines. Structurally, EPA's NONROAD model is made up of three specific components:

1) A Graphical User Interface (GUI), which allows the user to easily input model parameters;

2) The Core Model, which contains all computational algorithms; and

3) A Reporting Utility for viewing and summarizing modeled emissions estimates.

NONROAD-AT has a structure similar to that of NONROAD, but provides users with several enhanced features which allow users to more easily generate, keep track of, compare, archive, and share multiple sets of emissions modeling scenarios. A modeling scenario in NONROAD-AT represents any unique set of Core Model inputs. For example, different scenarios might be generated to represent different sets of assumptions about future activity growth and equipment technologies. NONROAD-AT stores all Core Model inputs and outputs along with identifying information (user name, organization, comments) corresponding to a particular model scenario. Since users may wish to work with scenarios generated by several different analysts working within the same or different departments or agencies, NONROAD-AT provides facilities for users to easily document and share scenarios with one another.

OVERVIEW OF NONROAD-AT

NONROAD-AT provides a replacement for the GUI and Reporting Utility provided with the standard version of the NONROAD model. The standard NONROAD Core Model is retained, so emissions calculations generated by NONROAD-AT will be identical to those generated by the standard model. As in the EPA model, the NONROAD-AT GUI provides the user with an easy method to specify the options for an emissions scenario. With simple Windows-type menus and pull-down screens, the user can quickly set up, execute, and view a modeling scenario. The user specifies modeling options by clicking on the choices desired in a series of dialog boxes. Once the model options are specified, the user can then run the Fortran Core Model from within the interface, and then can move directly to the Reporting Utility to view and summarize the modeling results. The NONROAD-AT Reporting Utility, written using Microsoft's ACCESS 2000 database software, is used to create standardized reports using output data generated by the Core Model. Like the GUI, the reporting utility is a fully operational Windows program, with pull-down menus, designed as a separate module in order to take advantage of the many reporting and formatting options available when using a database application.

Emission Scenarios

The NONROAD-AT GUI provides users with an easy method for developing and analyzing a series of off-road emissions scenarios. With simple Windows-type screens and pull-down menus, users can quickly set up, document, execute, and view multiple emissions scenarios. Each emissions scenario is associated with a collection of meta data. Users enter this meta information via a GUI dialog (see Figure 1). All of the information shown on this dialog is stored with the input files used for the scenario in the scenario's archive file. Archive files are used by NONROAD-AT to keep a permanent record of each NONROAD model scenario. Archive files can be used to easily recreate the results of a previous Core Model run and can be shared among different NONROAD-AT users. Users can view the run identifier assigned to an archive file along with the run meta data from that file using the File ∋Edit ∋Archives command in the NONROAD-AT GUI. Archive files are simple ASCII text files which can be viewed with the Windows Notepad utility or any other text editing program. A complete discussion of NONROAD-AT archive files can be found in the NONROAD-AT User's Guide.[2]

Model Inputs

The NONROAD Core Model estimates emissions for each specific type on off-road equipment by multiplying the following estimates:

- Equipment population for base year (or base year population grown to a future year), distributed by age, power, fuel type, and application;
- Average load factor expressed as average fraction of available power;
- Activity in hours of use per year; and

- Emission factor with deterioration and/or new standards.

The emissions are then temporally and geographically allocated using appropriate allocation factors.

Several input files are used to provide necessary information to calculate and allocate these emissions estimates: emission factors, base year equipment population, activity, load factor, average lifetime, scrappage function, growth estimates, and geographic and temporal allocation. EPA provides default values for all input files and these files are included in the NONROAD-AT distribution. Users can replace the default data files when better information becomes available or when different estimates or control factors are needed, either from EPA for national defaults or from local sources for locality-specific data. During development of NONROAD-AT, input files were modified to test control strategies for three Texas rule makings as described in the NONROAD-AT User's Guide (Appendix A). These Texas-specific input files are also included with the NONROAD-AT distribution.

Reporting Utility

The NONROAD-AT Reporting Utility is similar to the Reporting Utility included with the standard NONROAD model. It's primary purpose is to provide users with several types of standard summary reports for a given modeling scenario. For most reports, emissions can be reported for either all counties or for a single, user-specified county. Reports that include emissions estimates by equipment types or by SCC are separated by major source classification (e.g., agricultural, lawn and garden), with subtotals provided for each classification. For those reports, equipment type descriptions are also included (e.g., 2-wheel tractors, asphalt pavers, etc.). Where appropriate, reports also include a grand total by pollutant.

In addition to generating and viewing standardized reports from a single modeling scenario, the Reporting Utility provides the user the ability to compare the results of two separate scenarios. The comparison reports are useful, for example, to compare emissions from present and future year projections, or to compare emissions with two different future year control programs. For comparison reports by SCC and horsepower by SCC, the report displays the results of the two scenarios, along with the absolute and percent difference between the scenarios. For the population and fuel comparison report, the report displays only the results of the two model runs side by side.

System Requirements

System requirements for NONROAD-AT are as follows:

- Windows 95, 98, NT 4 or 2000
- At least 150 mb available disk space
- Access 2000 installed
- A utility, such as Winzip, for unpacking .zip archive files

NONROAD-AT ENHANCEMENTS

As noted above, NONROAD-AT performs the same calculations as the standard NONROAD model but includes a number of enhancements that allow users to more easily track multiple modeling scenarios. In addition, NONROAD-AT includes the ability to output results in NIF 2.0 format. These and several other enhancements are briefly summarized in this section.

Summary of Enhancements to Standard NONROAD GUI Module

Scenario Meta Data Input

NONROAD-AT collects information about each modeling scenario via options and inputs users make in the revised GUI module. Users are prompted to enter descriptive information about each scenario; additional information is collected automatically based on selection of model input files and options.

Selecting and Editing Alternative Core Model Input Files

In addition to the modeling options specified in the .opt file, NONROAD-AT uses various input data files to complete emissions calculations. A complete set of EPA default files are included with the NONROAD-AT distribution along with a set of alternative input files that contain data specifically for Texas. These Texas-specific alternative input files are documented in the Appendix to the NONROAD-AT User's Guide. When running with the default TEMPLTX.OPT file, NONROAD-AT uses Texas specific input files in place of the EPA default files unless different selections are made under the Advanced Options menu. The contents of the different types of input files are described in Section 6 of the standard NONROAD User's Guide.[1]

In addition to allowing users to select alternative input files for a model run, NONROAD-AT includes a feature which allows you to edit the contents of the growth, activity, and equipment population input files directly via the NONROAD-AT GUI, rather than having to use a separate text editor program.

County Groups

One of the enhancements found in NONROAD-AT is the ability to more easily specify groups of counties as the geographic region of interest. County Groups are groups of counties that can be added to the modeling region via NONROAD-AT's Scenario ∋ Region menu by selecting the name of the group from the list of available groups instead of specifying each individual county to be added to the modeling region. When initially installed, NONROAD-AT includes a variety of pre-defined county groups within the state of Texas. The list of counties included in any of these groups can be modified, and new county groups can be defined, by using the File ∋Edit ∋County Groups menu. Procedures for specifying county groups in the Scenario ∋ Region menu and editing the definitions of county groups using the File ∋Edit ∋County Groups menu are described in the NONROAD-AT User's Guide.

Summary of Enhancements to Standard NONROAD Reporting Utility

NONROAD-AT's Reporting Utility is an enhanced version of the standard NONROAD model Reporting Utility. The new Reporting Utility is written in Access 2000. It provides users the ability to identify NONROAD model runs, view meta information for a run, and produce reports from the output of a model run. You can also use the reports module to purge selected runs from the NONROAD-AT database. Users can access the reports module via the Model ∋ Reports command in the NONROAD-AT graphical user interface.

A significant feature of the enhanced Reporting Utility included in NONROAD-AT is a facility for generating NIF 2.0 formatted data exports (in either database or ASCII text file forms). This feature allows NONROAD-AT users to more easily transmit emission estimates to EPA to meet reporting requirements.

Users can view information about each NONROAD model scenario stored in NONROAD-AT using the reporting utility's View Runs command. The View Runs command provides the ability to see details of any scenario which has been imported into the reporting utility. This command incorporates a search function that allows users to more easily sort through the set of available scenarios and identify the one to be viewed. Searches can be performed via a form based on several key scenario information fields:

1) Organization,
2) Contact Name,
3) County,
4) Year,
5) Period,
6) Types,
7) Season,
8) Month,
9) Day

The drop-down lists on the search form are populated with possible matches that exist in the database of available scenarios. In other words, if scenarios exist that only use the seasons of Spring and Autumn, then these two seasons will be the only values in the drop down list. The Run Selection screen is depicted in Figure 2.

Information about each model scenario stored in the NONROAD-AT database can be displayed in the Meta Data Run Detail form accessed from the Reporting Utility (see Figure 3). This form includes all of the meta data for the run, including the data entered when the run was created and additional information which is automatically stored with the run by NONROAD-AT (the Run ID, the name and version of the NONROAD core model used for the run, the date and time the run was created, and the name of the organization which created the run).

Clicking on the View Files button at the bottom of the Meta Data Run Detail form allows users to view detailed information about some of the input files used to make the NONROAD model run (see example in Figure 4). This information is stored in specially-formatted headers included at the top of each NONROAD-AT input data file. These headers store information about the status of the file (e.g., EPA Default, TNRCC SIP Default, Custom), who created the input file and when, and comments about the file. These headers appear as comments in the input files and do not interfere with the use of these files in the standard NONROAD model.

NONROAD-AT's Reporting Utility includes several additional reports not found in the standard version. Reports currently available in NONROAD-AT are:

1) Emission Totals by County,
2) Emission Totals by Equipment Type,
3) Emission Totals by Horsepower,
4) Emission Totals by HP and Source Classification,
5) Emission Totals by HP and SCC,
6) Emission Totals by SCC,
7) Hourly Emissions by SCC,
8) Emission Totals by Source Classification,
9) Population and Fuel Consumption by HP and Source Classification,
10) Population and Fuel Consumption by SCC.

NONROAD-AT also includes several reports designed to allow users to compare the results of two different modeling scenarios. Comparison results are presented both as absolute and relative (percentage) differences. The following comparison reports are currently available through the NONROAD-AT Reporting Utility:

1) Compare Two Model Runs by HP and Source Classification,
2) Compare Two Model Runs by Pop and Fuel,
3) Compare Two Model Runs by SCC,
4) Compare Two Model Runs by Source Classification,
5) Compare Two Model Runs by County,
6) Compare Two Model Runs by Horsepower,
7) Compare Two Model Runs by Equipment Type,
8) Compare Two Model Runs by HP and SCC.

CONCLUSIONS

User=s of EPA=s off-road emissions model, NONROAD, often have a need to easily store and retrieve information from multiple scenarios corresponding to different regulatory strategies, time periods, and locations. NONROAD-AT adds this functionality to the standard NONROAD model and incorporates several additional features, including the ability to output data in NIF 2.0 format for transmittal to EPA. NONROAD-AT includes as a separate, replaceable module the current Afinal draft@ version of EPA=s NONROAD core model which can be used to estimate both historical and future year emissions from most off-road equipment. NONROAD-AT can therefore be used in place of the standard NONROAD model by any users who might benefit from the enhancements built into the revised system.

REFERENCES

1. EPA, *User's Guide for the National NONROAD Emissions Model Draft Version*, U.S. Environmental Protection Agency, June, 1998.

2. ENVIRON, *User's Guide to the NONROAD Analysis Tool*. ENVIRON International Corp., 31 August, 2001.

Figure1. Run meta data screen.

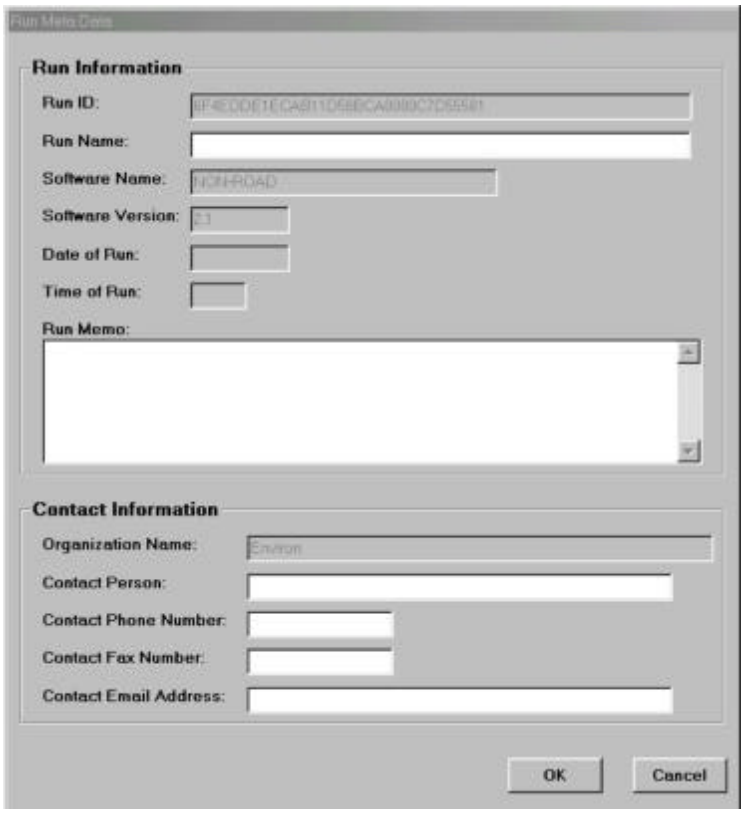


Figure 2. Run selection criteria dialog.

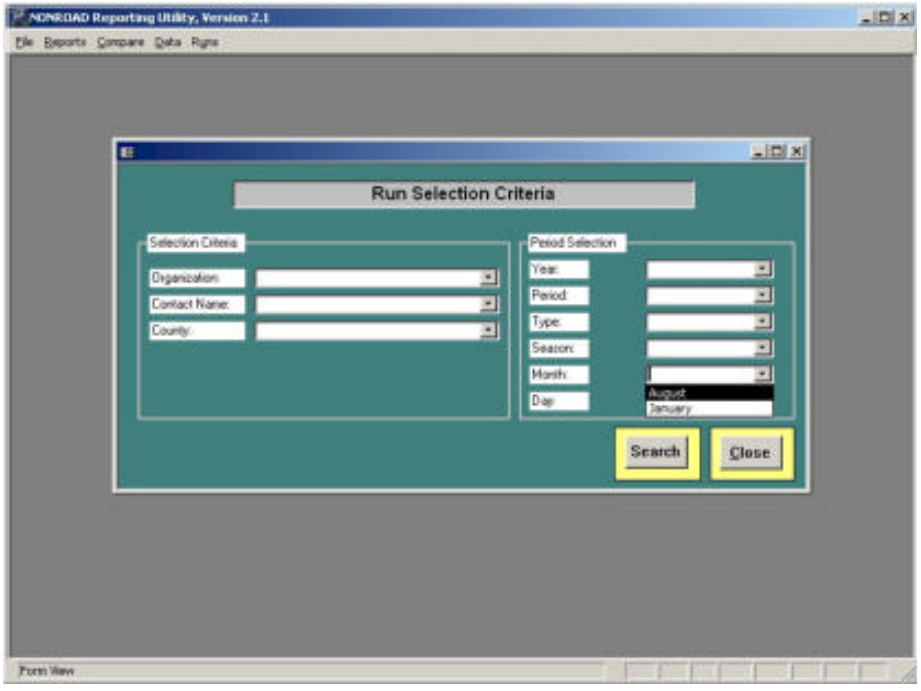


Figure 3. Modeling scenario meta data detail dialog.

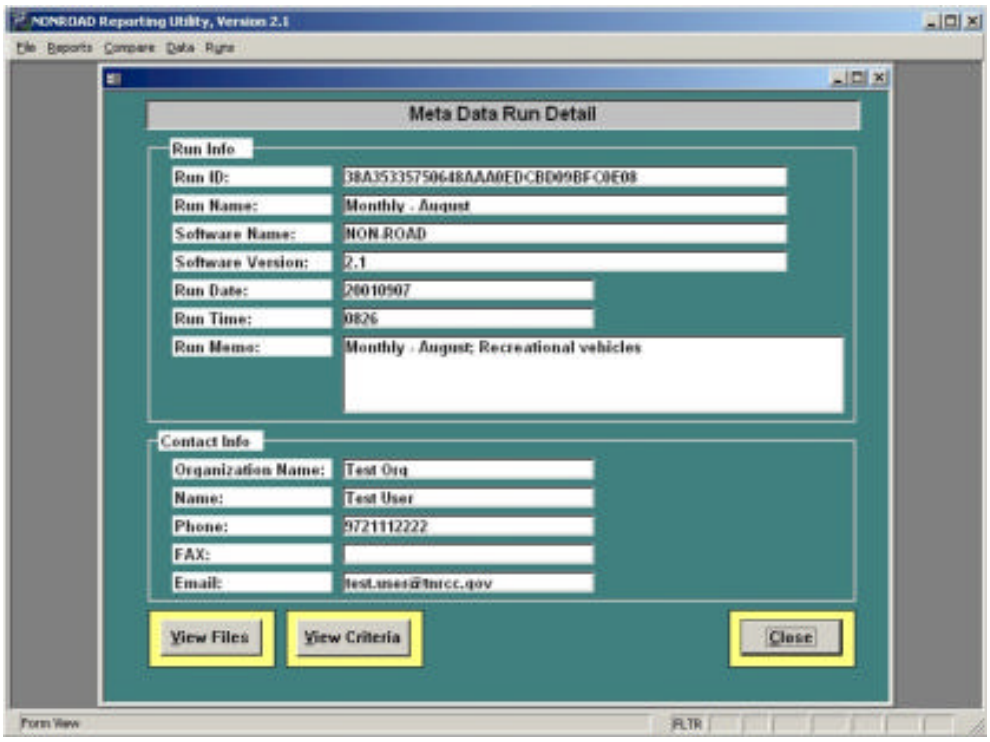
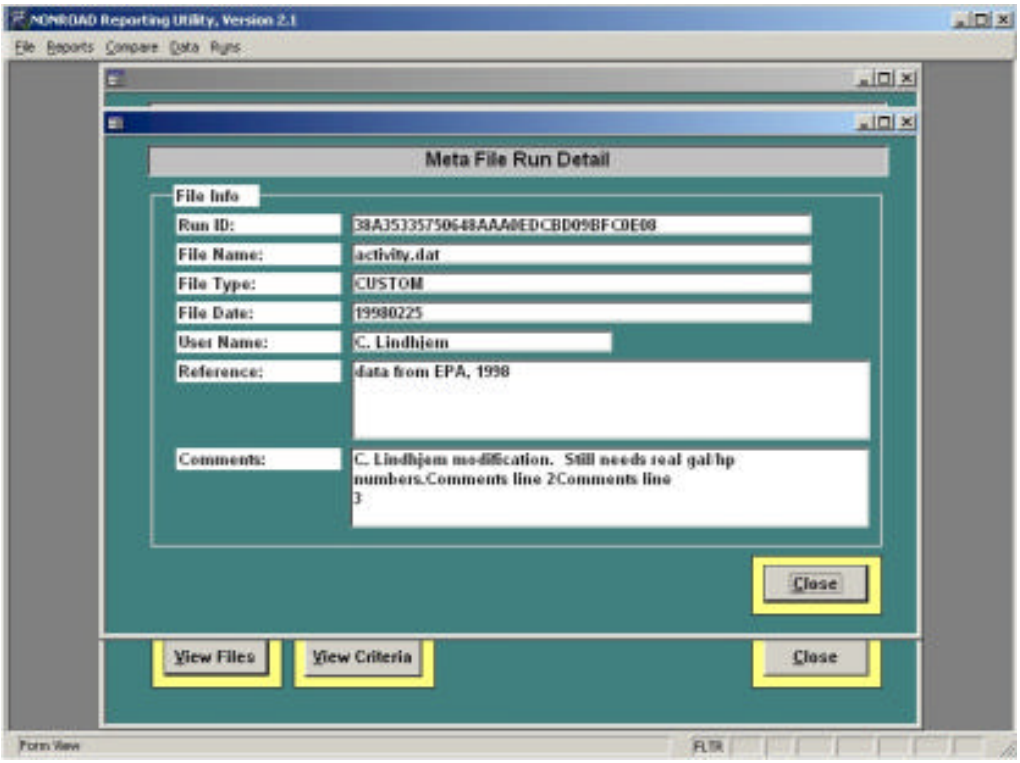


Figure 4. Meta file run detail display of header information from a NONROAD activity data file.



KEYWORDS

Mobile sources
NIF
Non-road emissions
Off-road emissions