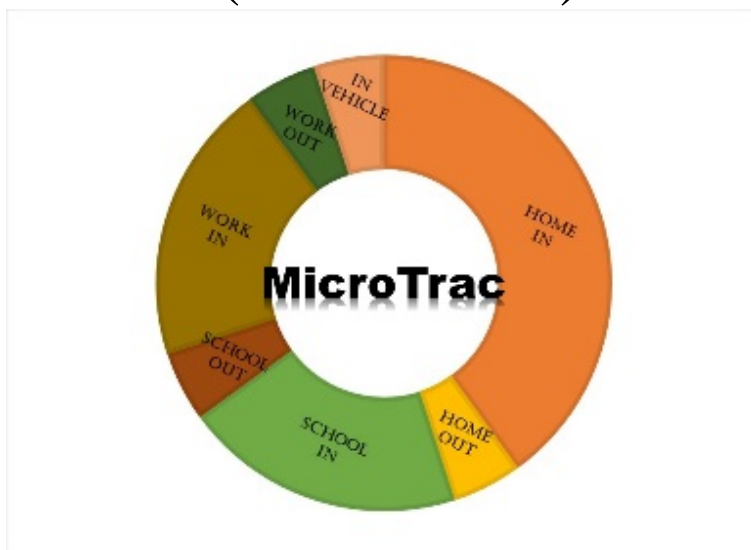


Microenvironment Tracker (MicroTrac)



Version 1.0

User Guide

Michael Breen

Email: breen.michael@epa.gov

U.S. Environmental Protection Agency
National Exposure Research Laboratory
Research Triangle Park, NC 27711

EPA Document Number: EPA/600/B-16/207

Table of Contents

Introduction	1
Installing MicroTrac	1
Running MicroTrac	2
MicroTrac Results	4
MicroTrac Test Run	6

Introduction

MicroTrac is a classification model that estimates time of day and duration spent in eight microenvironments (indoors and outdoors at home, work, school; inside vehicles; other locations) from global positioning system (GPS) data and geocoded building boundaries. The details of the MicroTrac algorithm are described in the peer-reviewed publication: Breen et al., *GPS-based Microenvironment Tracker (MicroTrac) Model to Estimate Time-Location of Individuals for Air Pollution Exposure Assessments: Model Evaluation in Central North Carolina*. J Expo Sci Environ Epidemiol. 2014 24:412-420.

MicroTrac is available as a standalone executable, which was developed and compiled using Matlab (version: R1015a, manufacturer: MathWorks, Natick, MA, USA). All Matlab functionality required by the model is provided by the MATLAB Components Runtime package that is automatically downloaded during installation of MicroTrac.

MicroTrac executes on the user's local computer, and no input or output data is transferred on the internet. Therefore, no personal identifiable information within the input or output files is transferred from the user's computer.

MicroTrac has some limitations. First, MicroTrac does not run on Apple computers since it was compiled on a Windows computer. Second, MicroTrac requires specific GPS input data that may not be available from all types of GPS data loggers. See Section "Running MicroTrac" for input data requirements. Third, MicroTrac requires GPS samples every 5 seconds. These input data requirements are needed to match those used during our evaluation of MicroTrac (Breen et al, J Expo Sci Environ Epidemiol. 2014 24:412-420). Finally, users must provide local dawn and dusk times for the days with GPS data. Future versions of MicroTrac will address these limitations.

Installing MicroTrac

MicroTrac must be installed on a 64-bit Windows computer. User needs system administrator privileges on computer. Computer needs internet connection during installation to download Matlab runtime software from Mathworks.

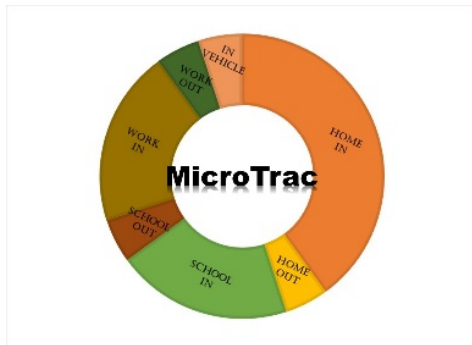
To start the installation, download installation file (MicroTrac 1.0 Installation.exe). After download has completed, double click installation file (MicroTrac 1.0 Installation.exe) and follow these steps:

1. The 'Destination Location' screen will automatically appear. The default destination folder is displayed on the screen (C:\Program Files\ MicroTrac 1.0). To change the drive or location of the folder for the MicroTrac program, press the 'Browse' pushbutton. To install the program in the default location or user-specified location, press the 'Next' pushbutton.
2. If this is the first installation of the MicroTrac on the computer, a 'MATLAB Runtime is required' screen will appear. The installation folder for MATLAB runtime will automatically appear. The default destination folder is displayed (C:\Program

Files\MATLAB\MATLAB Runtime). To change the drive or location of the folder for the program, press the 'Change' pushbutton. Press the 'Next' pushbutton to continue.

3. The "License agreement" screen will appear. Click "Yes" and press the "Next" pushbutton to continue.
4. The "Confirmation" screen will display the destination folders for the MicroTrac and MATLAB runtime, also the download size (around 470MB) for the installation. Press the "Install" pushbutton to begin the installation process.
5. The 'Downloading' screen will automatically appear displaying progress as the files for the installation are downloading.
6. Wait while a progress bar is displaying. This may take more than several minutes (less than 30 minutes) to finish.
7. Then a final window "installation completed successfully" confirming successful installation will appear. Press the 'Finish' pushbutton to close the window.

After installation is complete, the following icon will be placed on desktop.



Running MicroTrac

1. To start MicroTrac, double click on MicroTrac desktop icon. After start-up, MicroTrac displays the main graphical user interface (GUI) shown in Figure 1. Note: program start-up time may be a few minutes for first run after installation, and much shorter for subsequent runs.

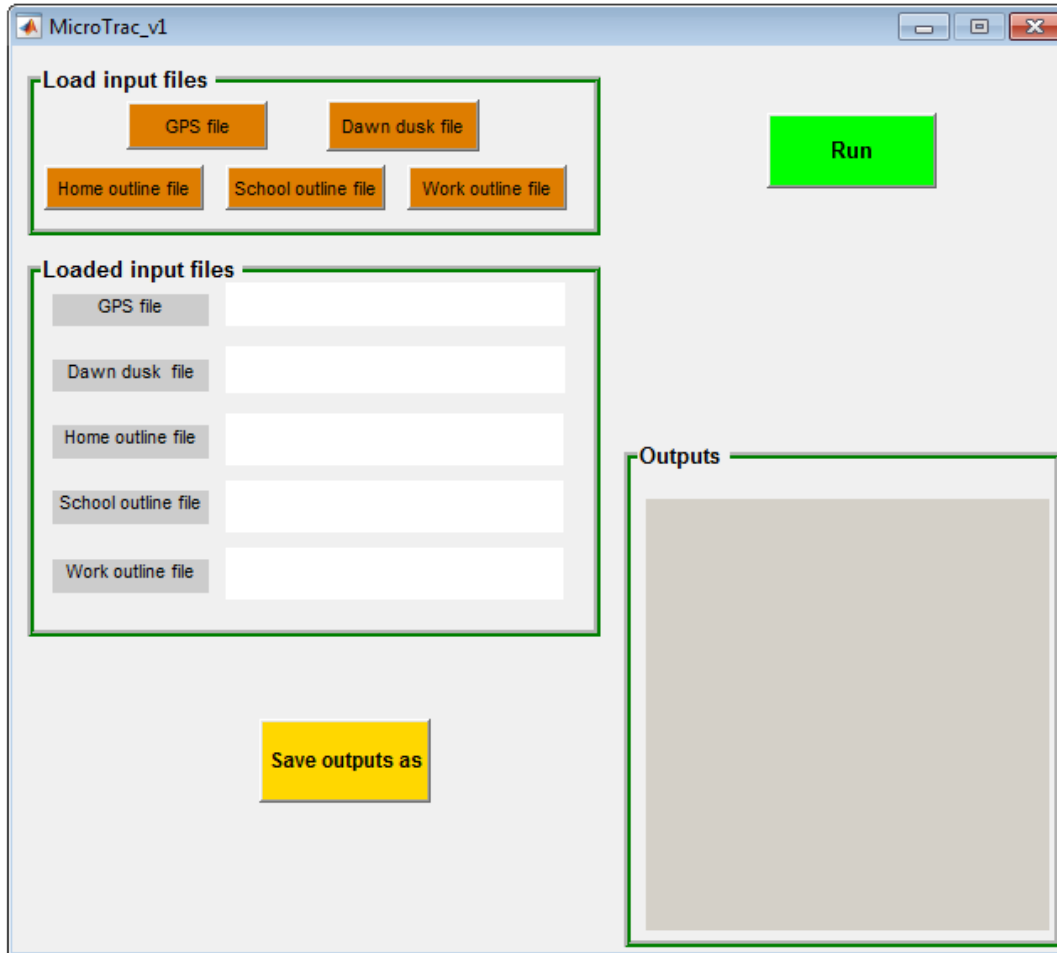
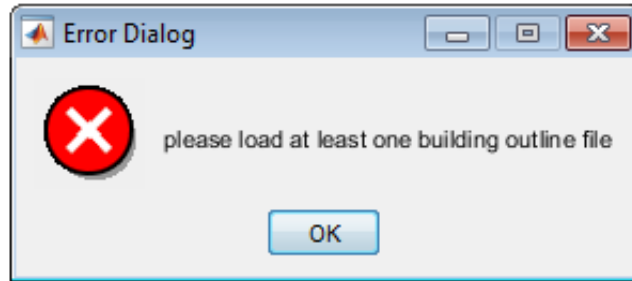


Figure 1. MicroTrac GUI

2. To load input files, click push buttons in “Load Input Files” panel of GUI. There are three types of input files: (1) GPS text file (.csv format) that contains location, speed, and GPS signal quality data; (2) dawn and dusk file (.csv format) that includes astronomical dawn and dusk time for each day with GPS data; (3) building outline files (.kml format) for home, school, and work. All loaded input files should be displayed under the “Loaded input files” panel of GUI.

Note: A minimum of one building outline file must be loaded to run MicroTrac. If no outline files are loaded before pushing the “Run” button, the following error message will be displayed:



For the GPS file, MicroTrac requires GPS data samples every 5 sec, and uses the file format created by the GPS data logger used in our studies (model: BT-Q1000XT, manufacturer: QStarz International, Taiwan). To create a GPS file, copy the column headers from the test run GPS data file: “test_gps_data.csv”. The input data used by MicroTrac includes: column 5 – local data, column 6 - local time, column 9 - latitude, column 11 - longitude, column 14 - speed (km/h), column 18 – position dilution of precision (PDOP); column 21 - number of satellites used (NSAT). The other columns of data are not used by MicroTrac, but “dummy” values must be included for MicroTrac to correctly read the GPS file.

For the dawn and dusk file, MicroTrac uses the following file format: column 1: month (MM), column 2: day (DD), column 3: year (YYYY), column 4: astronomical dawn (HHMM), column 5: astronomical dusk (HHMM). See test run file: (“dawn_dusk_times.csv”).

To create building outline files using Google Earth:

- 1) Open Google Earth
 - 2) In the Search field, enter the address of the building
 - 3) Zoom in until the building outline is visible
 - 4) From the ‘Add’ pull-down menu, select ‘Path’
 - 5) Enter building filename but do not click ‘OK’ yet
 - 6) Outline building with cursor and left-click at the corners of building
 - 7) When building outline is complete, click ‘OK’
 - 8) Go to the ‘File’ pull-down menu and select ‘Save’, then scroll over and select ‘Save Place As’. Make sure saved filename is correct, and choose .kml file type.
3. To run MicroTrac, click on “Run” button in GUI. A wait bar will appear (“please wait MicroTrac is running”). When MicroTrac is done, wait bar will close and MicroTrac results will be displayed in “Outputs” panel of GUI (Figure 2), which shows percentage of time spent in each microenvironment.
4. To save MicroTrac results, click on “Save outputs as” and specify filename and location of output file. Note: a default output file is automatically saved in the folder where MicroTrac is installed, and named: “MicroTrac_results_mm-dd-yyyy.txt”.

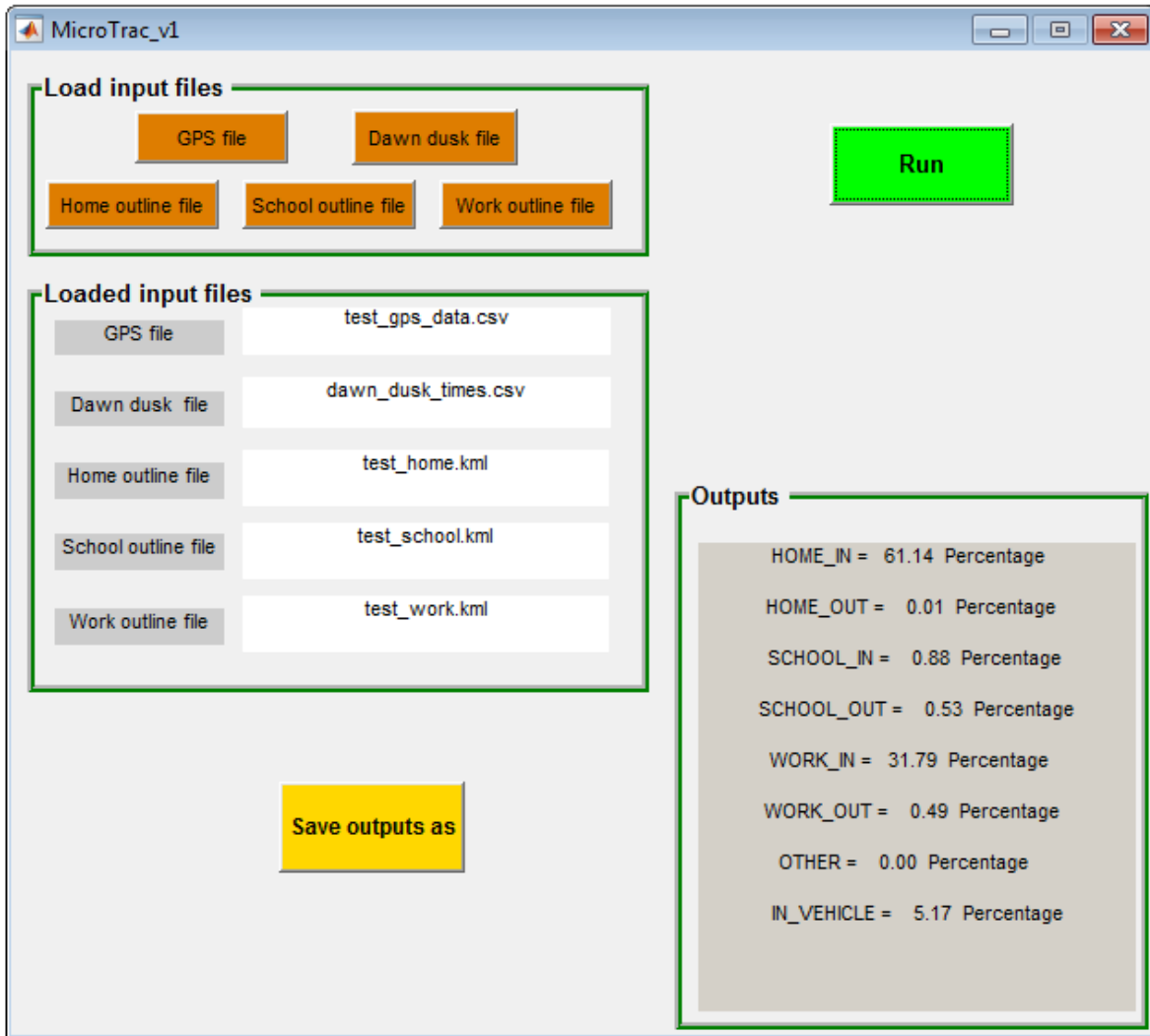


Figure 2. Example MicroTrac outputs in GUI

MicroTrac Results

MicroTrac output file (Figure 3) includes: (1) chronological list of microenvironments entered with corresponding date and time of day when entering, (2) duration (number of samples) and percentage of time spent in each microenvironment.

```

HOME_IN 2010/11/02 09:02:26
IN_VEHICLE 2010/11/02 09:08:39
SCHOOL_OUT 2010/11/02 09:18:04
SCHOOL_IN 2010/11/02 09:19:24
SCHOOL_OUT 2010/11/02 09:20:52
IN_VEHICLE 2010/11/02 09:21:36
WORK_OUT 2010/11/02 09:34:31
WORK_IN 2010/11/02 09:38:38
WORK_OUT 2010/11/02 10:17:38

```

```
WORK_IN 2010/11/02 10:17:43
WORK_OUT 2010/11/02 10:20:58
WORK_IN 2010/11/02 10:21:08
IN_VEHICLE 2010/11/02 17:15:23
SCHOOL_OUT 2010/11/02 17:32:38
SCHOOL_IN 2010/11/02 17:33:08
SCHOOL_OUT 2010/11/02 17:44:18
IN_VEHICLE 2010/11/02 17:49:09
HOME_IN 2010/11/02 18:00:09
HOME_OUT 2010/11/03 08:34:54
IN_VEHICLE 2010/11/03 08:34:59
WORK_OUT 2010/11/03 08:58:59
WORK_IN 2010/11/03 09:01:38
WORK_IN 2010/11/03 09:02:28

HOME_IN = 10573 Samples
HOME_OUT = 1 Samples
SCHOOL_IN = 152 Samples
SCHOOL_OUT = 91 Samples
WORK_IN = 5497 Samples
WORK_OUT = 85 Samples
OTHER = 0 Samples
IN_VEHICLE = 894 Samples

HOME_IN = 61.14 Percentage
HOME_OUT = 0.01 Percentage
SCHOOL_IN = 0.88 Percentage
SCHOOL_OUT = 0.53 Percentage
WORK_IN = 31.79 Percentage
WORK_OUT = 0.49 Percentage
OTHER = 0.00 Percentage
IN_VEHICLE = 5.17 Percentage
```

Figure 3. Example MicroTrac output file

MicroTrac Test Run

To test MicroTrac, user should run MicroTrac with test run input files (“test_gps_data.csv”, “dawn_dusk_time.csv”, “test_home.kml”, “test_school.kml”, “test_work.kml”). Then, MicroTrac results can be compared with test run MicroTrac output file (“test_results.txt”), as shown in Figure 3.