United States
Environmental Protection
Agency

Air and Radiation

EPA420-R-05-017
December 2005
NR-004c

Seasonal and Monthly Activity Allocation Fractions for Nonroad Engine Emissions Modeling

EPA420-R-05-017
December 2005

Seasonal and Monthly Activity Allocation Fractions for Nonroad Engine Emissions Modeling

NR-004c

Assessment and Standards Division
Office of Transportation and Air Quality
U.S. Environmental Protection Agency

NOTICE

This technical report does not necessarily represent final EPA decisions or positions. It is intended to present technical analysis of issues using data that are currently available. The purpose in the release of such reports is to facilitate the exchange of technical information and to inform the public of technical developments which may form the basis for a final EPA decision, position, or regulatory action.

Introduction

The United States Environmental Protection Agency (EPA) has developed a national nonroad air emissions inventory model called NONROAD. The model uses estimates of annual activity for each equipment type, e.g., generally expressed in terms of hours of operations or gallons of fuel used per year, to calculate yearly emission inventories. It will also calculate inventories on a seasonal (i.e., summer, fall, winter, spring), monthly, or daily (i.e., weekday or weekend day) basis by allocating annual activity to these smaller time periods. This report documents the seasonal and monthly activity allocation fractions used by the model. Daily activity allocation fractions are addressed in a separate technical report. The only substantive change from draft NONROAD2004 is the seasonal allocation of construction equipment, described in the Methodology/Results section below. Seasonal inputs have also been added for Puerto Rico and the U.S. Virgin Islands, simply by assigning them to the Southeast region and using those existing values. The EPA currently considers these seasonal fractions to be final inputs for the draft NONROAD2005 model.

The remainder of this report is organized into two parts. The first part contains a basic description of the overall approach and sources of information that are used to develop the requisite temporal allocation fractions. The second part explains how this information is used and describes the final default values for each state.

Background

The draft NONROAD2005 model allocates annual activity for the various equipment categories to each month of the year based on the general climate and geographic location of the state and the time of year in which the equipment is used. Seasonal inventories are computed by combining the monthly activity fractions that comprise each of the four seasons as shown in Table 1.

Table 1
Season and Month Correspondence

Season	Month
Summer	June, July, and August
Fall	September, October, and November
Winter	December, January, and February[a]
Spring	March, April, and May

[a] When running the model for the winter season, it assumes January, February, and December all in the same year, rather than the preceding December.

The monthly activity allocation fractions used in NONROAD were derived from the seasonal activity factors contained in the November 1991 Nonroad Engine and Vehicle Emission Study[1] (NEVES) and monthly activity factors contained in a technical report for the California Air Resources Board (CARB) nonroad emissions model - OFFROAD.[2] The EPA decided to develop the activity allocation fractions based on these two documents as default values for the NONROAD model. To the best of the EPA's current knowledge, these two sources of information represent the most comprehensive work that has been done to date concerning the distribution of activity by season and month for a broad range of nonroad equipment categories on a statewide (CARB) and nationwide (EPA) basis. The EPA recognizes that states and other users of NONROAD may have more detailed information on their local activity levels by season and month. Such users of NONROAD may substitute activity allocation fractions derived for a state, county, or air quality management district based on surveys or other studies for any of the equipment categories.

The data from NEVES can be found in Appendix L, Tables L-02, L-03, and L-04 of that document, which contain percentages of activity for summer and winter use only (Attachment 1).[b] More specifically, Table L-02 contains summer and winter activity allocations for agricultural, construction, industrial, lawn and garden (excluding chainsaws), snowblower/snowmobile, commercial marine, airport service, logging (including chainsaws), and light commercial equipment. These percentages were derived from a paper written by Hare and Springer,[3] 1987 state implementation plan (SIP) inventories, and the CARB Technical Support Document for proposed regulations applicable to lawn and garden equipment.[4] Separate summer and winter activity allocations for these general equipment categories are provided for three climatological and geographical regions (cold/northern, medium/central, and warm/southern). These regions are defined by the average January temperature and latitude criteria shown in Table 2.

Table 2
Seasonal Activity Allocation Fraction Regions Defined by Hare and Springer

Region	Average January Temperature (°F)	Latitude
Cold/Northern	< 35°	43° and north
Medium/Central	35° - 44°	37° to 43°
Warm/Southern	> 45°	37° and south

Table L-03 contains summer and winter activity allocations for recreational marine equipment from a boat usage survey done for the National Marine Manufacturers Association

[b] The derivation of allocation factors for the fall and spring using the NEVES summer and winter values is explained in the next section.

(NMMA).[5] The factors in this table are arranged into eight geographical regions: Northeast, Southeast, Mid-Atlantic Coast, Great Lakes, Southwest, Rocky Mountains, Northwest, and West Coast.

Table L-04 contains summer and winter activity allocations for recreational equipment from a survey done for the Motorcycle Industry Council (MIC).[6] Table L-04 lists twelve regions. However, the list of regions was subsequently found to be in error, based on a list received from the MIC that defines the geographical regions used for its survey. The corrected information was used in the development of the allocation scheme for NONROAD.

The MIC organized the seasonal activity usage results into four regions (East, Midwest, South, West), which the MIC further divided into eight subregions: New England and Middle Atlantic[c] (East); East Central and West Central (Midwest); Southeast and Southwest (South); and Rocky Mountains and Pacific (West). In Table L-04, the allocations for the main regions are averages of the two subregions that form each of the main regions.

The CARB model has activity allocations for the State of California, which are expressed in monthly form (Attachment 2). The allocation fractions are described in the OFFROAD model's technical support document. The CARB factors differ from those contained in NEVES for agriculture, construction, industrial, lawn and garden, snowblowers/snowmobile, and recreational equipment. The CARB technical document did not contain allocations for certain categories (i.e., commercial and recreational marine[d]), and it differed from NEVES in that it contained separate factors for tillers, chainsaws less than or equal to five horsepower and transportation refrigeration units. CARB and NEVES had equivalent allocations for the remaining categories where usage was judged to be essentially uniform over the year. As described in the next section, the CARB allocation factors are used directly for most equipment categories in the draft NONROAD2005 to model emissions in the State of California.

---

[c] In NEVES, Middle Atlantic was changed to be Mid-Atlantic Coast. However, in the documentation of the geographic definitions received from the MIC, it is labeled at Middle Atlantic.

[d] For commercial marine, as well as aircraft and locomotives, baseline emissions in tons per day were directly entered into the OFFROAD model and a growth factor was used to project emissions into the future. Therefore, seasonal activity allocation fractions were not needed. No explanation is given for why no seasonal activity allocation fractions are listed for recreational marine equipment.

Methodology/Results

NEVES-Based Regional Activity Allocations

Because each of the seasonal allocation tables in NEVES contains different numbers and types of geographical regions, composite regions were created for use in NONROAD by geographically matching the less defined regions from Tables L-02 and L-03 to those in Table L-04. This correspondence is shown in Table 3. The resulting ten composite regions represent an attempt to reconcile and link the regions defined in each of the three tables so that they are geographically coherent and compatible.

Table 3
Mapping of Seasonal Activity Allocation Regions From NEVES to NONROAD

NEVES General Equipment Table L-02	NEVES Recreational Marine Table L-03	NEVES Recreational Equipment Table L-04	NONROAD Composite Regions
Cold/Northern	Northeast, Great Lakes, Northwest, Rocky Mountains	Midwest, New England, Rocky Mountains, East Central	Northeast/New England, Great Lakes/Midwest, Rocky Mountains, Northwest
Medium/Central	Mid-Atlantic Coast, West Coast	Mid-Atlantic Coast, West Central, Pacific,	Middle Atlantic, West Coast, Central West
Warm/Southern	Southeast, Southwest	South, Southeast, Southwest	Southeast, Southwest, South Central

There were two exceptions in regard to the general method of defining the regions discussed above. The first involved a decision to leave out the East Central region found in Table L-04 for recreation equipment from the composite regions because the region that it defined could be included in and reasonably characterized by the Great Lakes/Midwest region.

The second exception pertained to the allocation factors used for the general equipment categories included in the Rocky Mountains category for NONROAD. In Table L-02, the general equipment categories used in this geographic area would have been classified as Medium/Central by the criteria previously shown in Table 2. This classification may seem reasonable since the Rocky Mountains region is generally located in the central part of the U.S. However, the climatic conditions found in most of the Rocky Mountains more closely resemble the northern part of the U.S. than the central section of the country. Therefore, NONROAD uses the Cold/Northern seasonal activity allocation factors from Table L-02 for the general equipment categories included in the Rocky Mountains category. This rationale is also supported by Table L-01 in NEVES, which classified the nonattainment area of Denver as being within a cold region.

Since the seasonal allocation factors for all of the categories except recreational equipment were arranged in more general regions than the ten composite regions described above, these values were used multiple times based on the matching strategy in Table 3. For example, the cold/northern fractions from Table L-02 are used in the Northeast/New England, Midwest/Great Lakes, Rocky Mountains, and Northwest regions.

Because the allocation tables in NEVES include only summer and winter factors, it was also necessary to develop allocations for the remaining two seasons. These allocations were determined by taking the sum of the summer and winter allocation percentages for each equipment category and geographical region represented in the NEVES tables, and subtracting this value from one hundred. The resulting value was then divided by two to obtain the fall and spring allocation percentages.

The monthly allocation fractions required by NONROAD can be computed from the NEVES-based seasonal allocation percentages by first dividing the seasonal percentages for each equipment category and region described above by 100 to convert from percentile to fractional form. Second, each seasonal allocation fraction was then divided by three to produce the allocation fraction for each month of the respective season (Table 1). The resulting monthly allocation fractions by equipment category for all regions except the West Coast, which is described below, are shown in Table 4.

This approach assumes that the four seasons are contained in specific three month periods, within which usage in each category is constant. For example, this results in NONROAD apportioning the use of snow-related equipment to December, January, and February because these are defined as the winter months. However, it is common knowledge that significant snow can occur in late fall and early spring in certain areas. While the NEVES-based method does not optimally reflect such conditions, in the absence of more specific regional or local data, the method provides a reasonable and logical approximation of the seasonal impacts on nonroad equipment usage for a national emission inventory model.

CARB-Based Regional Activity Allocations

An exception to the NEVES-based approach described above resulted from using the available fractions from the CARB OFFROAD technical support document for the State of California, which is represented in NONROAD by the West Coast region. Recreational marine was not included in the CARB model, so NONROAD uses allocations derived from NEVES. The resulting monthly allocation fractions by equipment category for the West Coast and for each of the other regions are shown in Table 4.

Construction Value-Based Regional Activity Allocations

The one industry segment that has been updated from the NEVES and CARB-based approaches described above is construction equipment. The county level construction dollar value data[7] that EPA acquired to update the geographic allocations for draft NONROAD2005[8] also included a breakout of construction expenditures by month. For consistency with the other seasonal inputs and to minimize effects of any potentially anomolous data at the individual state and month level, EPA aggregated these data into the seasons defined in Table 1 and the regions

defined in Table 5. The main change in these seasonal allocations relative to prior versions of NONROAD is a decrease in the difference between summer and winter activities. The new data indicate that a greater portion of construction activity occurs in winter months than was the case with the older data.

Table 4
Monthly Seasonal Activity Allocation Fractions
(Based mostly on Tables L-02, L-03, and L-04 in Appendix L in NEVES, but construction is based on 2003 value of construction)

Northeast/New England

Equipment Category	January	February	March	April	May	June	July	August	September	October	November	December
Agricultural	0.020	0.020	0.073	0.073	0.073	0.167	0.167	0.167	0.073	0.073	0.073	0.020
Construction	0.059	0.059	0.093	0.093	0.093	0.095	0.095	0.095	0.086	0.086	0.086	0.059
Industrial	0.067	0.067	0.083	0.083	0.083	0.100	0.100	0.100	0.083	0.083	0.083	0.067
Lawn and Garden excl. chainsaws	0.020	0.020	0.073	0.073	0.073	0.167	0.167	0.167	0.073	0.073	0.073	0.020
Snowblowers/Snowmobiles	0.333	0.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.333
Airport Service	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Logging (incl. chainsaws)	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Light Commercial	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Recreational Marine	0.003	0.003	0.052	0.052	0.052	0.230	0.230	0.230	0.052	0.052	0.052	0.003
Recreational Equipment	0.047	0.047	0.070	0.070	0.070	0.146	0.146	0.146	0.070	0.070	0.070	0.047

Table 4 Continued

Great Lakes/Midwest

Equipment Category	January	February	March	April	May	June	July	August	September	October	November	December
Agricultural	0.020	0.020	0.073	0.073	0.073	0.167	0.167	0.167	0.073	0.073	0.073	0.020
Construction	0.061	0.061	0.089	0.089	0.089	0.099	0.099	0.099	0.086	0.086	0.086	0.061
Industrial	0.067	0.067	0.083	0.083	0.083	0.100	0.100	0.100	0.083	0.083	0.083	0.067
Lawn and Garden excl. chainsaws	0.020	0.020	0.073	0.073	0.073	0.167	0.167	0.167	0.073	0.073	0.073	0.020
Snowblowers/Snowmobiles	0.333	0.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.333
Airport Service	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Logging (incl. chainsaws)	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Light Commercial	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Recreational Marine	0.000	0.000	0.050	0.050	0.050	0.233	0.233	0.233	0.050	0.050	0.050	0.000
Recreational Equipment	0.027	0.027	0.077	0.077	0.077	0.153	0.153	0.153	0.077	0.077	0.077	0.027

Rocky Mountains

Equipment Category	January	February	March	April	May	June	July	August	September	October	November	December
Agricultural	0.020	0.020	0.073	0.073	0.073	0.167	0.167	0.167	0.073	0.073	0.073	0.020
Construction	0.066	0.066	0.079	0.079	0.079	0.100	0.100	0.100	0.089	0.089	0.089	0.066
Industrial	0.067	0.067	0.083	0.083	0.083	0.100	0.100	0.100	0.083	0.083	0.083	0.067
Lawn and Garden excl. chainsaws	0.020	0.020	0.073	0.073	0.073	0.167	0.167	0.167	0.073	0.073	0.073	0.020
Snowblowers/Snowmobiles	0.333	0.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.333
Airport Service	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Logging (incl. chainsaws)	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Light Commercial	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Recreational Marine	0.000	0.000	0.052	0.052	0.052	0.230	0.230	0.230	0.052	0.052	0.052	0.000
Recreational Equipment	0.027	0.027	0.080	0.080	0.080	0.147	0.147	0.147	0.080	0.080	0.080	0.027

Table 4 Continued

Mid-Atlantic

Equipment Category	January	February	March	April	May	June	July	August	September	October	November	December
Agricultural	0.020	0.020	0.090	0.090	0.090	0.133	0.133	0.133	0.090	0.090	0.090	0.020
Construction	0.072	0.072	0.079	0.079	0.079	0.098	0.098	0.098	0.085	0.085	0.085	0.072
Industrial	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Lawn and Garden excl. chainsaws	0.020	0.020	0.090	0.090	0.090	0.133	0.133	0.133	0.090	0.090	0.090	0.020
Snowblowers/Snowmobiles	0.333	0.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.333
Airport Service	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Logging (incl. chainsaws)	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Light Commercial	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Recreational Marine	0.007	0.007	0.068	0.068	0.068	0.190	0.190	0.190	0.068	0.068	0.068	0.007
Recreational Equipment	0.040	0.040	0.078	0.078	0.078	0.137	0.137	0.137	0.078	0.078	0.078	0.040

Southeast

Equipment Category	January	February	March	April	May	June	July	August	September	October	November	December
Agricultural	0.020	0.020	0.100	0.100	0.100	0.113	0.113	0.113	0.100	0.100	0.100	0.020
Construction	0.078	0.078	0.080	0.080	0.080	0.089	0.089	0.089	0.086	0.086	0.086	0.078
Industrial	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Lawn and Garden excl. chainsaws	0.020	0.020	0.100	0.100	0.100	0.113	0.113	0.113	0.100	0.100	0.100	0.020
Snowblowers/Snowmobiles	0.333	0.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.333
Airport Service	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Logging (incl. chainsaws)	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Light Commercial	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Recreational Marine	0.023	0.023	0.075	0.075	0.075	0.160	0.160	0.160	0.075	0.075	0.075	0.023
Recreational Equipment	0.057	0.057	0.080	0.080	0.080	0.117	0.117	0.117	0.080	0.080	0.080	0.057

Table 4 Continued

Northwest

Equipment Category	January	February	March	April	May	June	July	August	September	October	November	December
Agricultural	0.020	0.020	0.073	0.073	0.073	0.167	0.167	0.167	0.073	0.073	0.073	0.020
Construction	0.069	0.069	0.081	0.081	0.081	0.102	0.102	0.102	0.080	0.080	0.080	0.069
Industrial	0.067	0.067	0.083	0.083	0.083	0.100	0.100	0.100	0.083	0.083	0.083	0.067
Lawn and Garden excl. chainsaws	0.020	0.020	0.073	0.073	0.073	0.167	0.167	0.167	0.073	0.073	0.073	0.020
Snowblowers/Snowmobiles	0.333	0.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.333
Airport Service	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Logging (incl. chainsaws)	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Light Commercial	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Recreational Marine	0.016	0.016	0.063	0.063	0.063	0.190	0.190	0.190	0.063	0.063	0.063	0.016
Recreational Equipment*	0.043	0.043	0.073	0.073	0.073	0.143	0.143	0.143	0.073	0.073	0.073	0.043

West Coast

Note: West Coast table uses CARB OFFROAD Seasonal Activity Allocation Fractions except for marine and construction.

Equipment Category	January	February	March	April	May	June	July	August	September	October	November	December
Agricultural	0.054	0.054	0.086	0.086	0.108	0.108	0.108	0.108	0.108	0.075	0.054	0.054
Construction	0.072	0.072	0.088	0.088	0.088	0.090	0.090	0.090	0.083	0.083	0.083	0.072
Industrial	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Lawn and Garden excl. chainsaws	0.057	0.067	0.086	0.086	0.095	0.095	0.095	0.095	0.095	0.086	0.076	0.067
Snowblowers/Snowmobiles	0.200	0.200	0.180	0.060	0.020	0.000	0.000	0.000	0.000	0.000	0.140	0.200
Airport Service	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Logging (incl. chainsaws)	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Light Commercial	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Recreational Marine*****	0.023	0.023	0.075	0.075	0.075	0.160	0.160	0.160	0.075	0.075	0.075	0.023
Recreational Equipment	0.060	0.060	0.070	0.080	0.090	0.100	0.100	0.100	0.090	0.090	0.090	0.070

*****CARB OFFROAD did not have marine seasonal allocation fractions, so NEVES data are used for these.

Table 4 Continued

Central West

Equipment Category	January	February	March	April	May	June	July	August	September	October	November	December
Agricultural	0.020	0.020	0.090	0.090	0.090	0.133	0.133	0.133	0.090	0.090	0.090	0.020
Construction	0.070	0.070	0.089	0.089	0.089	0.094	0.094	0.094	0.080	0.080	0.080	0.070
Industrial	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Lawn and Garden excl. chainsaws	0.020	0.020	0.090	0.090	0.090	0.133	0.133	0.133	0.090	0.090	0.090	0.020
Snowblowers/Snowmobiles	0.333	0.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.333
Airport Service	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Logging (incl. chainsaws)	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Light Commercial	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Recreational Marine	0.023	0.023	0.075	0.075	0.075	0.160	0.160	0.160	0.075	0.075	0.075	0.023
Recreational Equipment	0.027	0.027	0.080	0.080	0.080	0.147	0.147	0.147	0.080	0.080	0.080	0.027

Southwest

Equipment Category	January	February	March	April	May	June	July	August	September	October	November	December
Agricultural	0.020	0.020	0.100	0.100	0.100	0.113	0.113	0.113	0.100	0.100	0.100	0.020
Construction	0.075	0.075	0.084	0.084	0.084	0.091	0.091	0.091	0.084	0.084	0.084	0.075
Industrial	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Lawn and Garden excl. chainsaws	0.020	0.020	0.100	0.100	0.100	0.113	0.113	0.113	0.100	0.100	0.100	0.020
Snowblowers/Snowmobiles	0.333	0.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.333
Airport Service	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Logging (incl. chainsaws)	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Light Commercial	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Recreational Marine	0.023	0.023	0.075	0.075	0.075	0.160	0.160	0.160	0.075	0.075	0.075	0.023
Recreational Equipment	0.040	0.040	0.085	0.085	0.085	0.123	0.123	0.123	0.085	0.085	0.085	0.040

Table 4 Continued

South Central

Equipment Category	January	February	March	April	May	June	July	August	September	October	November	December
Agricultural	0.020	0.020	0.100	0.100	0.100	0.113	0.113	0.113	0.100	0.100	0.100	0.020
Construction	0.068	0.068	0.092	0.092	0.092	0.091	0.091	0.091	0.082	0.082	0.082	0.068
Industrial	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Lawn and Garden (excl. chainsaws)	0.020	0.020	0.100	0.100	0.100	0.113	0.113	0.113	0.100	0.100	0.100	0.020
Snowblowers/Snowmobiles	0.333	0.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.333
Airport Service	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Logging (incl. chainsaws)	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Light Commercial	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Recreational Marine	0.023	0.023	0.075	0.075	0.075	0.160	0.160	0.160	0.075	0.075	0.075	0.023
Recreational Equipment	0.050	0.050	0.082	0.082	0.082	0.120	0.120	0.120	0.082	0.082	0.082	0.050

As a general practice, EPA welcomes and encourages the use of locally-derived activity allocation data in place of national or regional default data. It is the EPA's judgment that state or local agencies, such as CARB, are usually in a better position than EPA to collect, assess, and/or develop local nonroad activity-oriented data that more realistically mirror local conditions. In the specific case of California, the use of the CARB fractions will help to ensure that EPA's NONROAD model produces compatible results with those from California's OFFROAD model when it is run for California. If possible, EPA will incorporate data from other local sources in future model revisions when such information becomes available.

Assignment of Regional Activity Allocations to States

The final task involves assigning states to each of the regions. These assignments are shown in Table 5. The West Coast region consists of California (since most of the seasonal allocation data comes from CARB) and Hawaii (due to lack of other specific data, and assuming that at least southern California has some similarity to Hawaii). Many of the other states have logical assignments. However, some states do not clearly belong in a particular region because they span more than one of the defined regions and/or have several climatic tendencies that resemble more than one region. New York could be included in the Great Lakes/Midwest, Northeast/New England, or Middle Atlantic regions. Pennsylvania could be included in the Great Lakes/Midwest or Middle Atlantic regions. Wyoming could be included in the Central West, Rocky Mountain, or Northwest regions. In these cases, the EPA's best judgment was used based on general knowledge of the state's climate, general geographical position, and information from the NEVES report. Alaska, which has two CO nonattainment areas (Fairbanks and Anchorage), presented another problem. It should have its own unique seasonal allocation fraction data. However, lacking this data, it seemed logical to classify it as a Midwest/Great Lakes state, since the climatic conditions in Alaska bear the closest resemblance to the states assigned to that region.

Table 5

Mapping of States to Regions Used For Defining Monthly Activity Allocation Fraction

FIPS	State	Region
1.	Alabama	Southeast
2.	Alaska	Great Lakes/Midwest*
4.	Arizona	Southwest
5.	Arkansas	South Central
6.	California	West Coast
8.	Colorado	Rocky Mountains
9.	Connecticut	Mid-Atlantic
10.	Delaware	Mid-Atlantic
11.	District of Columbia (Washington, D.C.)	Mid-Atlantic
12.	Florida	Southeast
13.	Georgia	Southeast
15.	Hawaii	West Coast
16.	Idaho	Northwest
17.	Illinois	Great Lakes/Midwest
18.	Indiana	Great Lakes/Midwest
19.	Iowa	Great Lakes/Midwest
20.	Kansas	Central West
21.	Kentucky	South Central
22.	Louisiana	Southeast
23.	Maine	Northeast/New England
24.	Maryland	Mid-Atlantic
25.	Massachusetts	Northeast/New England
26.	Michigan	Great Lakes/Midwest
27.	Minnesota	Great Lakes/Midwest
28.	Mississippi	Southeast
29.	Missouri	Great Lakes/Midwest
30.	Montana	Northwest
31.	Nebraska	Central West
32.	Nevada	Central West

FIPS	State	Region
33.	New Hampshire	Northeast/New England
34.	New Jersey	Mid-Atlantic
35.	New Mexico	Southwest
36.	New York	Northeast/New England
37.	North Carolina	Mid-Atlantic
38.	North Dakota	Great Lakes/Midwest
39.	Ohio	Great Lakes/Midwest
40.	Oklahoma	South Central
41.	Oregon	Northwest
42.	Pennsylvania	Mid-Atlantic
44.	Rhode Island	Mid-Atlantic
45.	South Carolina	Southeast
46.	South Dakota	Great Lakes/Midwest
47.	Tennessee	South Central
48.	Texas	Southwest
49.	Utah	Central West
50.	Vermont	Northeast/New England
51.	Virginia	Mid-Atlantic
53.	Washington	Northwest
54.	West Virginia	Mid-Atlantic
55.	Wisconsin	Great Lakes/Midwest
56.	Wyoming	Rocky Mountains
72.	Puerto Rico	Southeast*
78.	Virgin Islands	Southeast*

*Although Alaska should have unique seasonal adjustment fractions, for the purpose of default data, Alaska has been assigned to the Midwest/Great Lakes profile because of a lack of data at this time. Similarly, Puerto Rico and the U.S. Virgin Islands have been assigned to the Southeast regional profile due to lack of data specific to those territories.

National Average Seasonal and Monthly Activity Allocations

Since seasonal activity fractions can vary considerably with region, they are most useful when performing state or county level model runs. However, the NONROAD model does have the capability to model seasonal and monthly emissions for a nationwide scenario, even though such results would lack the seasonal specificity of state or county level runs. To estimate national average seasonal and monthly activity allocations the monthly activity allocations were used as described

below. The resulting values are included in the SEASON.DAT input data file with the region designation of "US."

Due to the different seasonal activity allocations and different geographic allocations of the various types of equipment, the national average seasonal allocations are calculated as follows. Any set of equipment that has the same temporal and geographic allocations can be handled together, which is why there are not more than about 75 different types of equipment for this purpose.

1) Do twelve "50STATE" model runs (one for each month of the year) including all equipment types to generate activity (and emission) estimates for each state for each month for every type of equipment. Use the same temperature and fuel properties for all runs, since the seasonal allocation factors are just meant to allocate activity, regardless of emissions.

2) Aggregate the activity outputs from Step 1 across all states by SCC and month. This yields one activity value for each SCC and month (approximately 75 x 12 = 900).

3) Also aggregate those activity outputs across all states and months by SCC to get one national annual total activity value for each SCC (approximately 75 values).

4) For each of the equipment types listed in SEASON.DAT find the ratio of each month's activity from Step 2 to the annual total from Step 3.

5) In the /MONTHLY/ packet of SEASON.DAT, in the "US" section for the US total allocations, put the twelve monthly ratios from Step 4 into each appropriate line (using the global SCC where possible, such as 2270002000 for all diesel construction equipment, or individual SCCs where necessary due to equipment specific temporal activity profiles).

References

1. Environmental Protection Agency, Office of Air and Radiation. Nonroad Engine and Vehicle Emission Study, 21A-2001, November 1991.

2. Energy and Environmental Analysis. Documentation of Input Factors For the New Off-Road Mobile Source Emissions Inventory Model - Draft. Prepared for the California Air Resources Board, August 1995. OFFROAD was formerly know as MVOFF

3. Hare, C.T., and K.J. Springer. Exhaust Emissions from Uncontrolled Vehicles and Related Equipment Using Combustion Engines, Part 5, No. APRD-1494. San Antonio, TX:Southwest Research Institute, October 1973.

4. California Air Resources Board. Technical Support Documents for California Exhaust Emission Standards and Test Procedures for 1994 and Subsequent Model Year Utility and Lawn and Garden Equipment Engines. Attachment C to CARB Mailout #90-64. El Monte, CA:State of California, December 1991.

5. Irwin Broh & Associates, Inc. NMMA Boat Usage Survey. Prepared for the National Marine Manufacturers Association, Des Plaines, IL, August 1991.

6. Burke Marketing Research. 1990 Survey of Motorcycle Ownership and Usage: Final Results Waves 1-12, Volume II. Conducted for the Motorcycle Industry Council, Inc. May 1991.

7. Construction valuation data for 2003 purchased by EPA from McGraw-Hill Construction (formerly F.W. Dodge Company).

8. Geographic Allocation of State Level Nonroad Engine Population Data to the County Level, NONROAD model report NR-014d, 2005.

Attachment 1

NEVES Seasonal Activity Allocation Fractions

Table L-02. Summer and Winter Percentages of Yearly Activity

Equipment Category	Cold/Northern		Medium/Central		Warm/Southern	
	Summer (%)	Winter (%)	Summer (%)	Winter (%)	Summer (%)	Winter (%)
Agricultural	50	6	40	6	34	6
Construction	43	10	38	15	33	20
Industrial	30	20	25	25	25	25
Lawn and Garden (excl. chain saws)	50	6	40	6	34	6
Snowblowers/Snowmobiles	0	100	0	100	0	100
Commercial Marine	25	25	25	25	25	25
Airport Service	25	25	25	25	25	25
Logging (including chain saws)	25	25	25	25	25	25
Light Commercial	25	25	25	25	25	25

Table L-03. Summer and Winter Percentages of Yearly Activity for Recreational Marine Equipment

Region	% During Summer	% During Winter
Northeast	68	1
Southeast	48	7
Mid-Atlantic Coast	57	2
Great Lakes	70	0
Southwest	48	7
Rocky Mountains	69	0
Northwest	57	5
West Coast	48	7

Table L-04. Summer and Winter Percentages of Yearly Activity for Recreational Equipment*

Region	% During Summer	% During Winter
East	42	12
Midwest	46	8
South	36	15
West	44	11
New England	44	14
Mid-Atlantic Coast	41	12
East Central	48	9
West Central	44	8
Southeast	35	17
Southwest	37	12
Rocky Mountains	44	8
Pacific	43	13
National Average	42	12

* Excluding snowmobiles

ATTACHMENT 2
CARB OFF-ROAD EQUIPMENT USE BY MONTH OF YEAR

Equipment Category	Fraction of Annual Use											
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Recreational Vehicles	0.061	0.061	0.071	0.081	0.091	0.101	0.101	0.101	0.091	0.091	0.091	0.071
Construction Equipment	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Industrial Equipment	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Lawn and Garden Equipment	0.057	0.067	0.086	0.086	0.095	0.095	0.095	0.095	0.095	0.086	0.076	0.067
Farm Equipment	0.054	0.054	0.086	0.086	0.108	0.108	0.108	0.108	0.108	0.0.75	0.054	0.054
Light Commercial Equipment	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Logging Equipment	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Aircraft GSE	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Transportation Refrigeration Units	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Snowmobiles & Snowblowers	0.200	0.200	0.180	0.060	0.020	0.000	0.000	0.000	0.000	0.000	0.140	0.200
Chainsaws (≤5 HP)	0.090	0.090	0.090	0.050	0.050	0.040	0.080	0.090	0.090	0.110	0.110	0.110
Tillers	0.030	0.030	0.040	0.150	0.150	0.150	0.110	0.110	0.110	0.040	0.040	0.040