MEMORANDUM

From: Gregory Stella, U.S. EPA, Emission Factor and Inventory Group
Re: Temporal Allocation of Annual Emissions Using EMCH Temporal Profiles
Date: April 29, 2002

The purpose of this memorandum is to provide instruction on the usage of the temporal allocation profile and weighting factor files as found on CHIEF's Emissions Modeling Clearinghouse (EMCH) website (http://www.epa.gov/ttn/chief/emch/temporal/index.html).

These factors have been developed to allow users to estimate monthly, weekly, and hourly emissions from annual emission data using the files found on the EMCH website. Generic file names will be used in this example, as the specific versions of these files may change from time to time. It is always best to ensure that you are using the latest available version of these data as possible. Note that these factors have not been developed for any particular model or emissions processor and the user is responsible for converting these data into the appropriate formats for their use. As of April 29, 2002, a FIPSST field has been added to the Source Category Code / Temporal Allocation Cross Reference File to include State-specific profile changes.

The following example assumes an industrial internal combustion turbine engine which fires distillate oil (diesel fuel) [SCC 20200101] and emits 150 tons of NOx per year. The calculations below will estimate emissions for the 2-3 PM hour on a Wednesday in March based on the temporal allocation and cross-reference files created by the date of this memo.

In order to convert these annual emissions into hourly estimates, the first step is to allocate the emissions to the month of study, in this example, March. From the Source Category Code / Temporal Allocation Cross Reference File, locate the SCC 20200101.

Table 1. Source Category Code / Temporal Allocation Cross Reference File

SCC	Monthly Profile	Weekly Profile	Diurnal Profile	FIPSST
...	...	...	...	...
20190099	262	8	33	00
20200101	**137**	**7**	**24**	**00**
20200102	215	7	24	00
...	...	...	...	...

On this record, the monthly profile code is found to be 137. If a profile is known to exist for a particular State, that State's FIPSST code would be provided in the Table's FIPSST column. The national default for all States is FIPSST = "00". The next step is to locate the associated weighting ratio for the profile code and month of study.

Table 2. Monthly Profile File

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
...	...	...	...	...	...	...	...	...	...	...	...	...	...
136	79	79	88	88	88	88	88	88	79	79	79	79	1002
137	79	79	**91**	91	91	85	85	85	78	78	78	79	**999**
138	79	79	92	92	92	83	83	83	79	79	79	79	999
...	...	...	...	...	...	...	...	...	...	...	...	...	...

In this case, March's weighting factor for monthly profile 137 is found to be 91 out of a total 999 or 0.091091. Therefore, assuming 150 tons NOx/yr emitted by this unit, the following equation is used to estimate emissions for March:

$$\text{Emission}_{\text{Month}} = \text{Emission}_{\text{Annual}} * (\text{Weight Factor}_{\text{Month}} / \text{Weight Factor}_{\text{Total}})$$

or using the parameters from our example,

$$\text{Emission}_{\text{Mar}} = 150 \text{ tons NOx/yr} * (91 / 999) = 150 \text{ tons NOx/yr} * 0.091091$$

$$\text{Emission}_{\text{Mar}} = 13.66 \text{ tons NOx}$$

To convert this monthly emission value into a day-specific estimate, the next step is to determine the average day emissions value and then convert the result to the day-of-week estimate using the Weekly Profile File. Again using the Source Category Code / Temporal Allocation Cross Reference File the weekly profile code is found to be 7. Locating the profile 7 in the Weekly Profile File shows that there is no variation in this category from day to day during the week.

Table 3. Weekly Profile File

Week	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Total
...	...	...	...	...	...	...	...	...
6	167	167	167	167	167	167	0	1000
7	143	143	**143**	143	143	143	143	**1000**
8	147	147	147	147	147	135	129	1000
...	...	...	...	...	...	...	...	...

The calculation of Wednesday specific emissions are then as follows. First the average monthly day must be estimated from the monthly total. As each monthly profile is not weighted for the specific number of days in each month, an average day per year is used in the calculation.

$$\text{Emission}_{\text{AveDay}} = \text{Emission}_{\text{Month}} / (\text{Days}_{\text{Year}} / \text{Months}_{\text{Year}})$$

$$\text{Emission}_{\text{AveDayMar}} = 13.66 \text{ tons NOx} / 30.42$$

$$\text{Emission}_{\text{AveDayMar}} = 0.4406 \text{ tons NOx/average March day}$$

This average day's emissions must now be converted to a Wednesday estimate. Using the weighting factor found in the Weekly Profile File, emissions for this day are calculated with the following equation:

$$Emission_{Day} = Emission_{AveDay} * [(Weight\ Factor_{Day} / Weight\ Factor_{Total}) / (Number_{AveDay} / Number_{DaysWeek})]$$

$$Emission_{Wed} = 0.4406 \text{ tons NOx} * (143 / 1000) / (1/7)$$

$$Emission_{Wed} = 0.4406 \text{ tons NOx}$$

Finally, now that the emissions for an average Wednesday in March are estimated, hourly distribution calculations must be preformed. From the Source Category Code / Temporal Allocation Cross Reference File the diurnal profile code is found to be 24. Locating the profile 24 in the Diurnal Profile File shows again that there is no variation in this category from hour to hour during the day.

Table 4. Diurnal Profile File

Hour	**...**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**...**	**Total**
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
23	...	435	435	435	435	435	435	435	435	435	435	435	435	435	435	...	10005
24	...	417	417	417	417	417	417	**417**	417	417	417	417	417	417	417	...	**10008**
25	...	508	763	847	847	847	847	847	847	847	847	763	508	254	85	...	9996
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

As a convention, hour 1 refers to the first hour of the day (midnight to 1 a.m.) local time, hour 2 refers to the second hour of the day (1 a.m. to 2 a.m.), etc. Therefore, for this example, we need hour 14 (2 p.m. to 3 p.m.). The hourly emissions for hour 14 of the example Wednesday in March are then calculated as follows:

$$Emissions_{Hr} = Emissions_{Day} * (Weight\ Factor_{Hr} / Weight\ Factor_{Total})$$

$$Emissions_{2p.m.} = 0.4406 \text{ tons NOx} * (417/10008)$$

$$Emissions_{2p.m.} = 0.0184 \text{ tons NOx}$$

Emissions Modeling Clearinghouse File Modifications

Temporal Profile Usage Memorandum
- March 15, 2001 Original Memo
- April 29, 2002 Revision to include State-specific profile usage

Source Category Code/Temporal Profile Cross-Reference Profile File
- December 14, 2000 Original File
- March 7, 2001 Revision to modify file format to dBase IV
- April 29, 2002 Revision to include State-specific fertilizer application cross-reference

Monthly Profile File
- December 14, 2000 Original File
- April 29, 2002 Revision to include State-specific fertilizer application profiles[1]
  These profiles are #'s 950 - 998

Weekly Profile File
- December 14, 2000 Original File

Diurnal Profile File
- December 14, 2000 Original File

[1]Based on data collected from "Usual Planting and Harvesting Dates for U.S. Field Crops," December 1997, USDA. http://usda.mannlib.cornell.edu/reports/nassr/field/planting/uph97.pdf